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Contents for March 30, 1933

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Mahoning Valley Water Plant Stresses Pre-Treatment.... 395
BY G. GALE DIXON

Gaviota Canyon Bridge Notable for Large Skew Angle.... 399
BY A. A. EREMIN

Steel Island for Offshore Oil Drilling..... 400
BY WALLACE A. SAWDON

Concrete Strength Increased by Spray Irrigation..... 401
BY E. H. BURROWS

Architecture Applied to Elevated Steel Tanks..... 403

Triangulating the Continent of North America..... 405
BY WILLIAM BOWIE

Eight Years' Upkeep Cost of Surface-Treated Gravel..... 407
BY J. T. BULLEN

Increasing the Capacity of Framed Timber Joints..... 408
BY F. O. DUFOUR

New City Hall and Esplanade for St. Paul Civic Center.... 410
BY GEORGE H. HERROLD

New Rail Section Adopted by A.R.E.A. at Chicago..... 412

Letters.....415
News.....418
Editorials.....416
Equipment.....423

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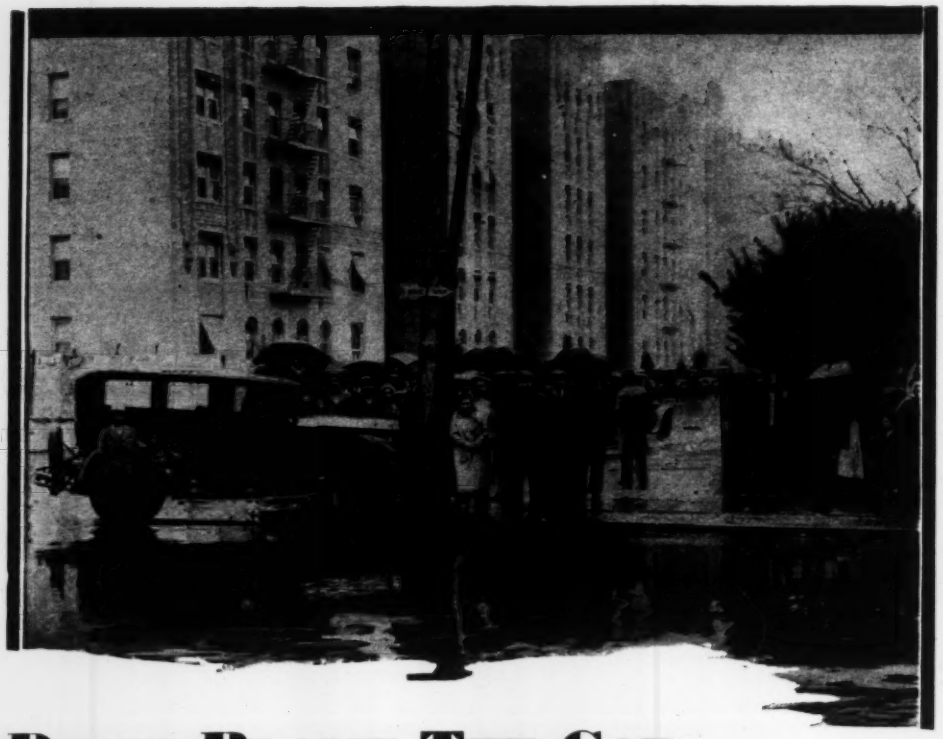

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Engineering News-Record

Vol. 110 New York, March 30, 1933 No. 13

New Mahoning Valley Water Plant.. 395
Skew Concrete Arch Bridge 399
Offshore Oil-Well Drilling 400
Strengthening Concrete by Spraying. 401
Elevated Tank Architecture 403
Triangulating North America 405
Costs of Surface-Treated Gravel.... 407
Modern Wood-Joint Connectors 408
St. Paul City Hall and Civic Center.. 410
New A.R.E.A. Rail Section..... 412
Fire-Hydrant Assembly 413
Re-Use of Old Bridge Girders..... 414
Letters to the Editor..... 415
Editorials 416
News of the Week 418
Equipment 423

New Water Plant Stresses Pre-Treatment

Generous space and modern equipment in purification and softening plant of the Mahoning Valley Sanitary District—Unusual conduit arrangement allows wide choice in routing water through mixing, settling and carbonization units

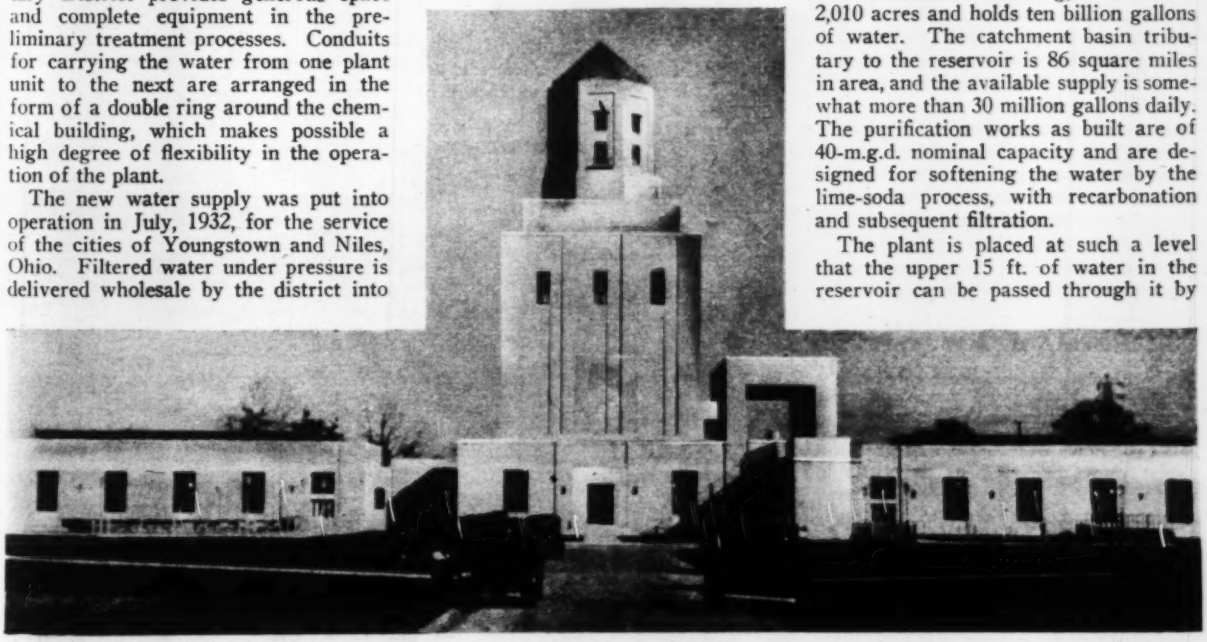
THE FOLLOWING ARTICLE is the first of a group describing the distinctive engineering features of the new water supply built by the Mahoning Valley Sanitary District to serve the cities of Youngstown and Niles, Ohio. In an early issue will appear a description of the unusual under-drain system in the filter plant. —EDITOR.

By G. Gale Dixon
Consulting Engineer, Youngstown, Ohio

INDICATIVE of the greater attention waterworks engineers today are giving pre-treatment in water purification, the new purification and softening plant of the Mahoning Valley Sanitary District provides generous space and complete equipment in the preliminary treatment processes. Conduits for carrying the water from one plant unit to the next are arranged in the form of a double ring around the chemical building, which makes possible a high degree of flexibility in the operation of the plant.

The new water supply was put into operation in July, 1932, for the service of the cities of Youngstown and Niles, Ohio. Filtered water under pressure is delivered wholesale by the district into the distribution system of the two cities, which retain responsibility for distribution and retail sales. The works constructed by the district comprise a dam and impounding reservoir on Meander Creek, purification and pumping works immediately below the dam, steel and cast-iron pipe lines for delivering water to Youngstown and Niles, a distributing reservoir at Youngstown and a standpipe at Niles.

Fig. 1—In the headhouse of the new Mahoning Valley water-purification plant, which is located between two pairs of mixing-settling units, are chemical-unloading equipment, chemical-storage bins, dry-feed machines and control devices.



The Meander Creek reservoir is formed by a dam 3,500 ft. long having a maximum height of 50 ft. The reservoir is about 7 miles long, covers some 2,010 acres and holds ten billion gallons of water. The catchment basin tributary to the reservoir is 86 square miles in area, and the available supply is somewhat more than 30 million gallons daily. The purification works as built are of 40-m.g.d. nominal capacity and are designed for softening the water by the lime-soda process, with recarbonation and subsequent filtration.

The plant is placed at such a level that the upper 15 ft. of water in the reservoir can be passed through it by

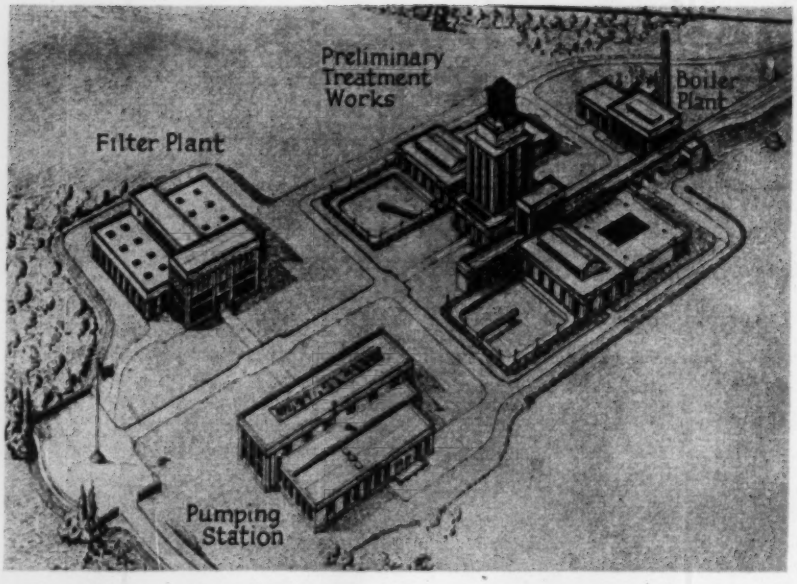


Fig. 2—The new water-purification plant comprises a preliminary-treatment plant, a filter plant, a pumping station and a boiler house. Treatment includes lime-and-soda softening and recarbonation.

gravity. From the gate house of the dam the water passes through a deep supply conduit about 700 ft. long to suction wells in the pumping station. Here the excess head, if any, is dissipated through control valves, and the water is screened. When the level of the water in the reservoir is too low to permit gravity flow, the screened water is raised to the level necessary by the low-lift pumps. The water then passes to the preliminary treatment works, where it is softened and settled; it then flows to the filter plant for filtration and chlorination. From clear wells beneath the filters the water passes through a masonry conduit lying deep in the ground to the high-lift suction well at the pumping station, from which it is picked up by motor-driven centrifugal pumps and discharged into the force mains leading to Youngstown and to Niles.

A short spur-track from the Niles and Lisbon branch of the Erie Railroad enters the plant grounds on embankment and reinforced-concrete trestle for delivery of coal and coke into pockets below track-grade abutting against the boiler house, and of chemicals to a car shed alongside the tower in the preliminary treatment works.

Preliminary treatment works

The natural water is only moderately hard, (140 p.p.m.), but in view of the constantly improving standards of quality of public water supplies and the difficulty of disposing of an unstable organic sludge under local conditions, the plant was designed for the lime-soda softening process, with the intention of delivering a finished water with a hardness of between 70 and 80 p.p.m.

Chemical treatment normally involves the application of about 5 grains of lime, 2 grains of soda ash and 0.5 grains of alum per gallon of water treated, with recarbonation and the return of sludge before final settling. All chemicals are fed dry. Mixing is accomplished by mechanical agitation. Settling basins are provided with mechanical equipment for the continuous removal of sludge. Sludge is discharged through a pipe line a quarter of a mile long into artificial lagoons at the rear of the site, where the solid matter is settled out and the excess water drained off to the creek.

Fig. 3—Water for the cities of Youngstown and Niles is obtained from Meander Creek, impounded by the Mineral Ridge Dam. Operation of distribution systems and retail sale of water will remain the responsibilities of the two cities.

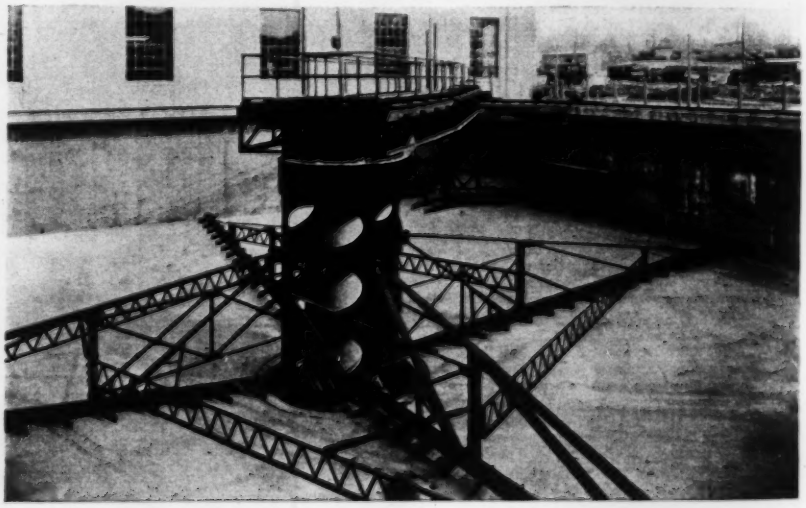
The preliminary treatment works fronts west with its principal axis running north and south, and comprises four separate units of mixing and settling basins and two carbonation basins, all grouped about a central headhouse. The headhouse consists of a single-story structure, 70x101 ft., surmounted by a tower.

Raw water enters and treated water leaves through pipe lines lying in the unobstructed ground in front of the headhouse, where space is reserved for future duplication of pipes when necessary. Routing of the flow through the several basins is accomplished by a double ring of conduits encircling the basement of the headhouse. Branch conduits for the service of the four individual mixing and settling units extend to the north and south along the principal axis of the works.

Two mixing and settling units lie symmetrically about the axial conduits on the north side of the headhouse, and two on the south side. To minimize ice troubles in winter, the mixing chambers and two of the settling basins are covered by low brick superstructures connecting with the headhouse; the other two basins are uncovered but are so constructed that they may be inclosed later if it is found to be desirable.

The two carbonation basins are of covered reinforced-concrete construction, located underground at the rear of the headhouse.

Fig. 4—Sludge-removal equipment for the settling basins has been designed to minimize ice troubles. The bridge is entirely above the water line, and the radial trusses are below. Water enters and leaves over adjustable weir plates at opposite sides of the tank.



The tower has a total height of 129 ft. from ground-floor level to the peak of the roof. The main shaft of the tower is about 50 ft. square and 70 ft. high and is structurally framed in nine bays. Eight of these bays are occupied by reinforced-concrete bins for the storage of chemicals, and the ninth accommodates a freight elevator and a stairway.

Chemicals are delivered in bulk in paper-lined box cars and are unloaded and delivered into the bins by vacuum-operated pneumatic conveying equipment, the provision for which controlled the height and proportions of the tower. Cars of chemicals are set in the shed alongside the tower, reached from the unloading platform at car-floor level. The chemicals are sucked out of the car through a 3-in. hose and are lifted by air velocity through piping to a receiver located in the lantern of the tower. From the receiver the chemicals fall by gravity through inclined pipes extending into the concrete bins. The vacuum pump, dust collector and other incidental equipment are located on the filling floor over the bins. In regular service two men unload from 6 to 8 tons of chemical per hour, with the total power consumed by the equipment ranging from 6 to 8 kw.-hr. per ton of material moved. The conveying equipment has a capacity of 8 tons per hour and operates substantially without dust or discomfort to the men.

Four bins are used for the storage of quicklime, two for soda ash and two for alum. Each bin is 14 ft. square and 29 ft. deep in the clear, including hopper bottoms, and holds some 80 to 90 tons of material. Two dry-feed machines are provided for each chemical. In the case of alum and soda a feed machine is located centrally under each bin and the hopper bottom of the bin is in the form of a rectangular octagonal pyramid with sides sloping at 60 deg. from the horizontal. One lime-feed machine is served by two bins, so the hopper bottoms of each pair of lime bins slope toward bin gates located on opposite sides of a vertical dividing wall and are in the form of regular octagonal semi-pyramids with sides sloping at 50 deg. from the horizontal. Bin gates are 18 in. square and are located at a height of 15 ft. above floor level.

Application of chemicals

The chemical-feed floor, 50 ft. square, is set 3 ft. above ground-floor level so as to give ample height above the water level of the basins. The dry-feed machines are suspended on scales provided with large indicating dials and recording charts. The weigh hoppers of the feed machines are filled by manual operation of the overhead bin gates, and the tops of the hoppers are piped up to the dust collector on the upper floor of the tower. The dust collector is operated by remote control while the hoppers are being charged, to prevent the scattering of dust about the headhouse.

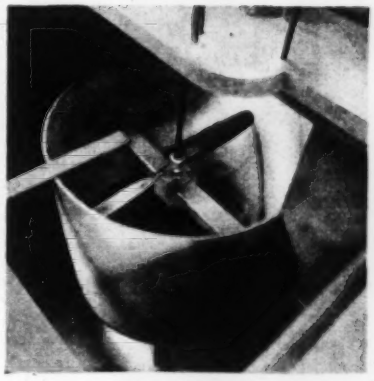
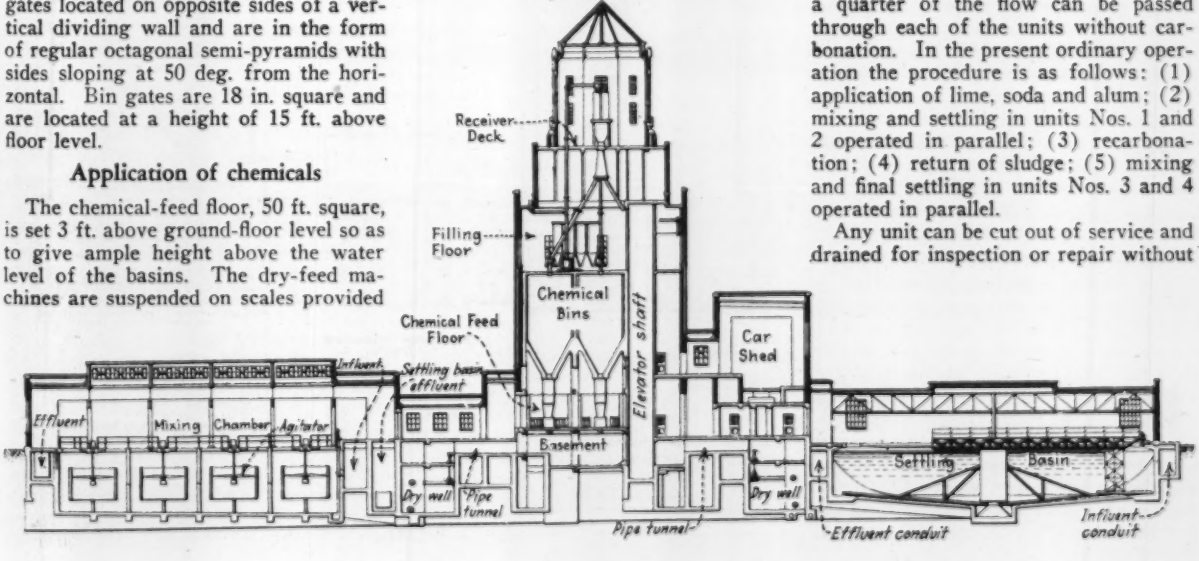


Fig. 5—Mixing is accomplished by propeller-type agitators, operating within concrete draft tubes. There are four of these agtitators for each mixing unit.

There is a full-sized basement under the chemical-feed floor, with four pipe tunnels large enough for men to crawl through leading to the several mixing chambers.

The chemical solutions are carried from the feed machines in 2½-in. rubber hoses, supported by a platform of light steel grating suspended from the basement ceiling and extending through the tunnels. The arrangement is such that chemical solution from any one of the several feed machines can be readily applied to the water at any desired point in the plant. Insoluble matter from the continuous lime slakers is passed through waste pipes into storage cans mounted on low-wheeled trucks in the basement, and is removed at intervals by a freight elevator.

Fig. 6—Longitudinal section through the preliminary treatment works along the line *AA* of Fig. 8.



Flexibility in operation

With a treatment process involving so many different steps and in the presence of so much mechanical equipment that will require periodical attention for painting and other maintenance work, a maximum degree of flexibility in plant operation is vitally necessary. This flexibility is obtained by arranging for the ready application of any chemical at any point and by a system of distributing and collecting conduits which permits of a high degree of choice in routing the flow of water among the different plant units.

Raw water enters the double ring of conduits in the headhouse foundation at the south side of the front of the building and progresses through the plant in a counter-clockwise direction. The mixing and settling units are numbered in corresponding counter-clockwise order: thus unit No. 1 is at the southwest corner, No. 2 at the southeast, No. 3 at the northeast and No. 4 at the northwest corner. The carbonation basins lie between units Nos. 2 and 3.

The two rings of conduits are so interconnected with each other and with the branch conduits serving the basins that by proper adjustment of stop-planks, handled through slots in the head-house floor, the four mixing and settling units can be operated in parallel, in series or in any desired combination of parallel and series arrangement, and carbonation can be effected either between units Nos. 2 and 3 or between units Nos. 3 and 4, provided only that flow be in a counter-clockwise direction, with unit No. 1 included in the first operation and unit No. 4 in the last. Thus, all of the water can be passed through the four mixing and settling units serially, with carbonation either between units Nos. 2 and 3, or between units Nos. 3 and 4; or a quarter of the flow can be passed through each of the units without carbonation. In the present ordinary operation the procedure is as follows: (1) application of lime, soda and alum; (2) mixing and settling in units Nos. 1 and 2 operated in parallel; (3) recarbonation; (4) return of sludge; (5) mixing and final settling in units Nos. 3 and 4 operated in parallel.

Any unit can be cut out of service and drained for inspection or repair without

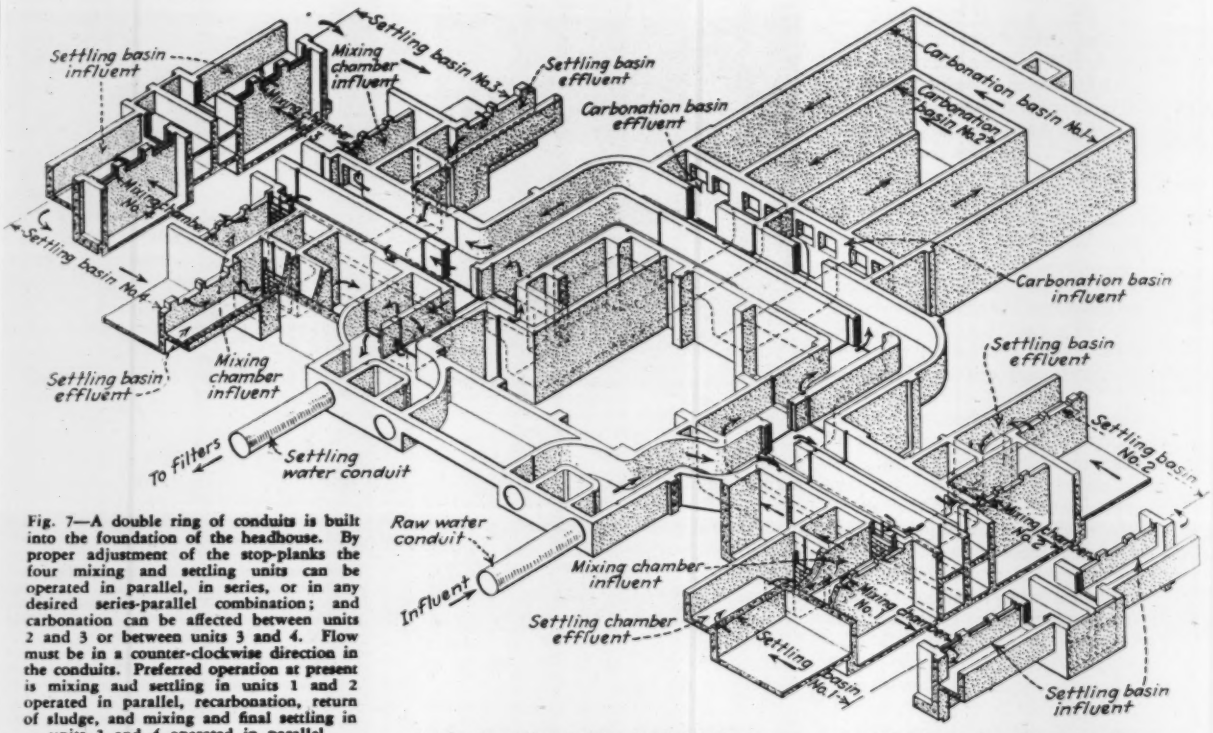


Fig. 7—A double ring of conduits is built into the foundation of the headhouse. By proper adjustment of the stop-planks the four mixing and settling units can be operated in parallel, in series, or in any desired series-parallel combination; and carbonation can be affected between units 2 and 3 or between units 3 and 4. Flow must be in a counter-clockwise direction in the conduits. Preferred operation at present is mixing and settling in units 1 and 2 operated in parallel, recarbonation, return of sludge, and mixing and final settling in units 3 and 4 operated in parallel.

interference with the operation of the rest of the works. The carbonation basins are built in two units only for the purpose of facilitating maintenance work; they cannot be operated in series.

Settling basins

Each settling unit consists of a settling basin and its accompanying mixing chamber. Sluice gates are provided at the inlet of the mixing chamber and at the outlet of the settling basin. By the manipulation of stop-planks the mixing chamber can be cut out of service while the settling basin is kept in operation.

The settling basins are each 95 ft. square, with a water depth of 12 ft. and a capacity of 800,000 gal. On the basis of a nominal plant capacity of 40 m.g.d. the four basins provide a total settling period of two hours.

Water enters the basin over an adjustable steel weir plate extending the full length of one side, encounters a wooden baffle that deflects it downward and flows straight across and out over a similar weir plate on the opposite side.

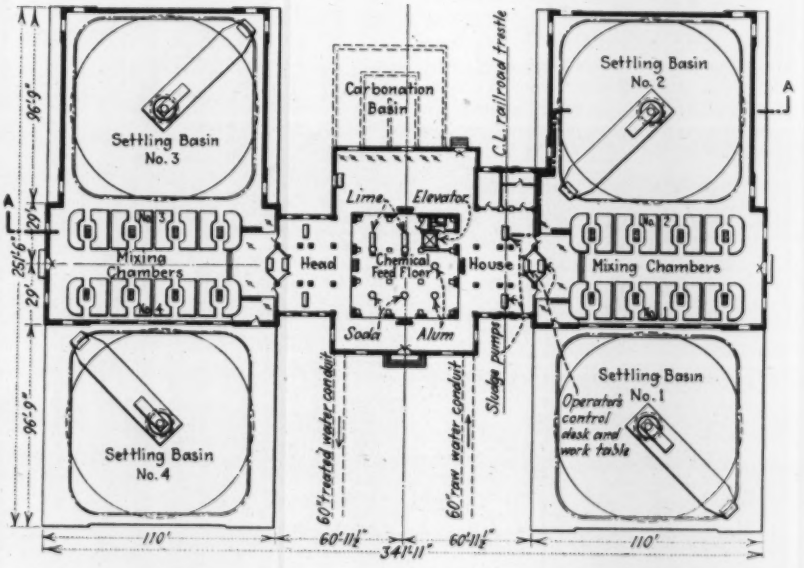
The sludge-collecting mechanism is built with a view to minimizing ice troubles during winter operation by virtue of several improvements over earlier designs. The traveling bridge structure clears the high-water level of the basin. The tops of the radial trusses that cantilever from the cage about the central pier for the support of the scrapers are kept below low-water level. The structural supports of the scraping mechanism that cleans the corners are attached to the traveling bridge by bolted connections so as to facilitate removal if necessary. It is thus possible, by temporarily omitting the scraping of the corner areas, to operate the mechanism without contact of any part with ice in the basin except for the rotating cylindrical steel cage about the central pier. This is made with smooth unbroken surface at water level so as to minimize resistance.

Mixing chambers

The mixing chamber serving each settling basin is 20 ft. wide, 83 ft. long and has a water depth of 15 ft. Each chamber has a content of about 185,000 gal. The four chambers therefore provide a total mixing period of about 25 min. on the basis of a nominal plant capacity of 40 m.g.d.

Water enters and leaves over concrete weir walls. Cross-beams with attendant posts and pilasters for stiffening the structure are located at intervals of 20 ft. in the length of the chamber, resulting in its subdivision into four cells each 20 ft. square in plan. In each of the four cells there is mounted an impeller agitator, 12 ft. in diameter, similar to an aeroplane propeller in form, which

Fig. 8—The four mixing-settling units are grouped around the headhouse.



revolves about a vertical shaft inside a draft tube of gun-deposited concrete. The draft tube is open at the bottom, and its top is below low-water level, so that the rotation of the impeller causes a slow pumping of water up through the draft tube and downward outside it.

Each agitator unit is driven by individual motor with speed reduction accomplished by combination of rope drive and gears. The speed of revolution of the impeller can be adjusted by changing the size of pulley used in the rope drive; and with individual motors as many units may be operated as seems advantageous to secure proper mixing.

Recarbonation

The carbonation basins have a capacity of about 320,000 gal., giving a 10-min. detention period at the nominal capacity of 40 m.g.d. The carbonation equipment in the boiler house consists of a coke gas producer, two gas-fired vertical boilers of 40-boiler hp. each, and duplicate units of scrubbers, driers and steam-driven compressors. The producer gas is burned under the boilers, generating steam used to drive the compressors. The gas from the boilers, containing between 16 and 18 per cent carbon dioxide, is scrubbed, dried and discharged by the compressors into the water through a grid of perforated brass piping on the floor of the carbonation basins.

Equipment in headhouse

The ground floor of the headhouse is separated at each end from the buildings housing the mixing chambers and settling basins (which are not heated) by a metal and glass partition. A central bay window projects out into the mixing-chamber structure to serve as a lookout post for the operator. A control desk is located in each bay window, carrying remote-control buttons and signal lights for the motor-driven equipment at that end of the plant. Immediately behind the control desk is a work table with a sink of the laboratory type, where the operator performs his hourly tests for the control of the softening process. Large illuminated dials showing the time and the quantity of water entering the plant are mounted on columns on the chemical-feed floor in such position as to be visible from the control desks at both ends of the building.

At each end of the building are two motor-driven sludge pumps of the duplex diaphragm type, designed to discharge against moderate pressure, so piped that either pump may draw from either or both of the two adjacent settling basins. All sludge suction and discharge piping within the limits of the structures is flanged and readily accessible for removal and cleaning, except the suction pipes running under the floors of the settling basins. These are arranged so that they may be rodded without difficulty. Piping connections are such that sludge from either the preliminary or the final settling of the water may be recirculated for aiding in the final settling process after recarbonation.

The Mahoning Valley Sanitary District from the time of its inception has been managed by a board of directors consisting of Jacob D. Waddell, president, of Niles, and Fred A. LaBelle, secretary-treasurer, of Youngstown. Engineering work was directed by William H. Dittoe, chief engineer, and the writer, as deputy chief engineer. Charles P. Hoover, consulting chemist, advised on chemical treatment.

Concrete-Arch Bridge Notable for Large Skew Angle

By A. A. Eremin
Assistant Bridge Designing Engineer, State Highway Commission, Sacramento, Calif.

ACCORDING to available information, the 57-deg. skew angle adopted for the new reinforced-concrete-arch bridge on the highway between San Luis Obispo and Santa Barbara in California is the largest ever used in this type of construction on this continent or in Europe. The bridge is located in Gaviota Canyon, and in the design of the bridge an effort was made to preserve the existing scenic beauty.

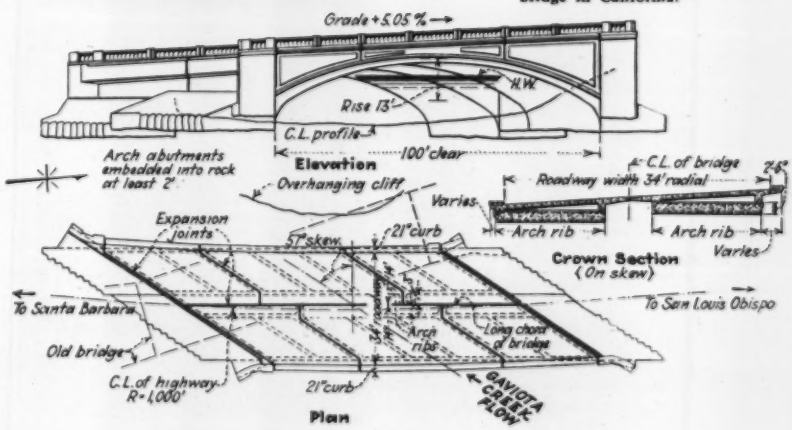
Fig. 1 — Picturesque setting in Gaviota Canyon in California for a new concrete-arch bridge with a skew of 57 deg.

The bridge is on a curve with a radius of 1,000 ft. and on a grade of 5.05 per cent. The roadway is 34 ft. curb to curb, with a superelevation of 15 in. An expansion joint in the roadway slab is placed along the long chord of the bridge, and each half of the slab is carried by a flat arch rib skewed at an angle of 57 deg. between a line normal to the arch face and a line parallel to the abutment face. The arch ribs are 2½ ft. thick at the crown and 6 ft. at the skewbacks, 14 ft. wide and spaced 20 ft. on centers. The clear span of the arch ribs is 100 ft. as measured along the center line, and the rise is 13 ft. The roadway deck slab is carried by the spandrel and the transverse walls. To reduce the stresses in the slab due to arch deformation, expansion joints are provided at the abutment walls and at the transverse walls.

To maintain traffic during construction, one half of the bridge was built at a time, a temporary timber trestle being placed to carry the traffic during the construction of the first half.

The bridge was designed and built by the state highway commission of California, of which C. H. Purcell is state highway engineer, F. W. Panhorst acting bridge engineer and H. D. Stover bridge designing engineer. R. D. Thorson was resident engineer on the work. Paul M. White was the contractor. The total cost was about $37,000.

Fig. 2—Design details of Gaviota Canyon bridge in California.



Steel Island for Offshore Oil Drilling

Accurate driving of steel piles required to secure stability sufficient for supporting oil-drilling derrick with top 168 ft. above ocean floor on California coast

By **Wallace A. Sawdon**
Petroleum Engineer, Los Angeles, Calif.

EXTREME accuracy in the location of the H-beam piles forming the substructure of a steel island was an important factor in the erection of an all-steel oil-well unit in the Pacific Ocean. The well is being put down by the Indian Petroleum Corp., near Ventura, Calif., but unlike other offshore locations it is at an isolated point 2,700 ft. from the shore and not connected with the land. The loads of the derrick and the heavy drilling equipment necessary for sinking the well presented especially serious problems at this location with the derrick floor 62 ft. above the ocean floor.

The well is located on a state tideland permit that extends about 4,000 ft. into the ocean. Four other wells have been drilled on similar permits, but all have been connected to the mainland by piers. This type of pier construction was described in *Engineering News-Record*, Nov. 13, 1930, p. 763. The most seaward of these is about 1,700 ft. from the island location. This pier was the base of construction operations for the island. An extension of the pier could have been made, but since there was no certainty that oil would be struck, the less expensive island construction was adopted in spite of the difficulties presented.

The section of the structure directly below the derrick was necessarily restricted to small tolerances, and the piles, which also served as columns, had to be accurately located and controlled during driving. The first problem was to provide falsework from which to drive piles, as barge driving would not be acceptable because of the accuracy required.

Four structural-steel towers were built on land and barged to the site. Each of these towers consisted of four 10-in. 30-lb. H-columns 60 ft. long, with the necessary bracing. These towers were 20 ft. square, and when set up together at the edge of the location provided a working platform nearly 45 ft. square. On this temporary staging the pile driver, hoist and other equipment were set up. No difficulty was experienced in placing the four towers, as they were welded into complete units before being taken to the site.

The main pier directly below the derrick consists of a four-pile unit below each leg and a central structural member of eight piles around the caisson through which the well is being drilled. All of these 24 piles were 10-in. H-columns driven through sand into shale, reaching a total penetration of about 8 ft. below the ocean floor at refusal.

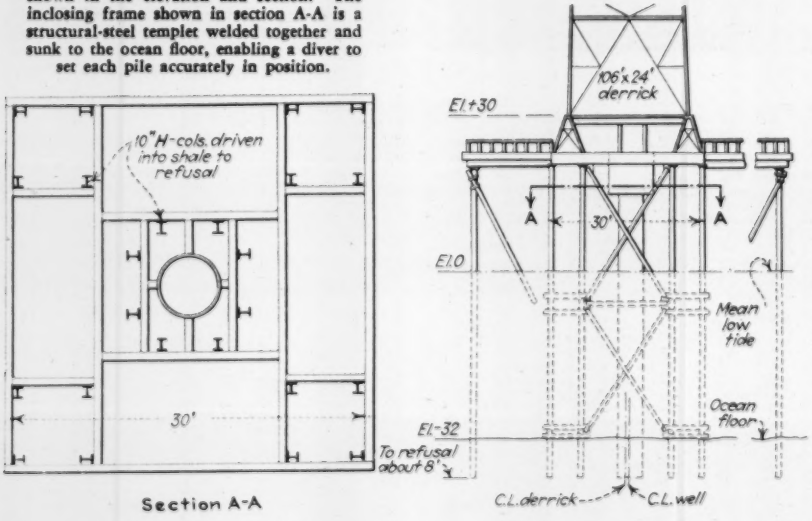
The accurate location and the control during driving were of great importance. Several plans were considered. Final decision was to use a structural-steel templet with members welded into the form shown in Fig. 3. The exact location of each pile was indicated on the templet, which was lowered to the ocean floor by the derrick barge and then aligned and leveled by divers. Each of the H-piles was carefully lowered and stabbed into place under the direction of the diver. The templet was left in place as part of the permanent structure.

A clamp to hold the swaybracing was made for each of the four-pile columns and fitted with a 6x¾-in. steel plate bent to encompass each pile. Gusset plates, with holes for pin connections to diagonals, were welded and fitted to this clamp, and the four clamps were then lowered to the water surface where the diagonals were attached. The clamp for the central well column was made with similar gusset plates for the diagonals. When this was connected to the corner clamps, the combined piece was similar in outline to the templet, above which it was set. A similar set of clamps was placed half way between the ocean floor and the deck. The swaybracing was then set, which provided guides for setting the well caisson. It was allowed to rock itself into the formation before it was plumbed and fastened.

Fig. 1—Half a mile offshore this oil-well location was made accessible by a man-made island built on steel piles.

Fig. 2—Heavy loads produced by a steel derrick reaching 168 ft. above the ocean floor, and deep drilling operations are supported on 10-in. H-columns driven into shale to refusal.

Fig. 3—Four-pile columns support each leg of the derrick, and eight piles surround and support the caisson for the well, as shown in the elevation and section. The inclosing frame shown in section A-A is a structural-steel templet welded together and sunk to the ocean floor, enabling a diver to set each pile accurately in position.



The diver fastened two steel plates on each pile and bolted them just above the lower clamp. The bracing was then placed in tension by means of turnbuckles. To overcome any tendency to twist, if eccentricity occurred on the corner columns, a steel diaphragm was welded over the entire rig area to form a web stiffener. In addition, this diaphragm helped to stiffen the structure against uplift during high seas and served as a subfloor below the derrick floor. These five compound columns, as braced and tied together, acted as the main pier designed to take the entire weight of the derrick and the stresses of the drilling operations.

A tank to serve as a sump for drilling mud and oil was suspended from and carried by the central ring of piles. The caisson, after rocking its way into the sand formation, was fastened into position at the top. The conductor pipe for the well was later run through this caisson and cemented below the surface of the ground. All steelwork above water level was electrically welded, and those connections that were necessary below the water surface were clamped and bolted.

The entire steel island is 60x90 ft. in plan. The derrick location is shown in Fig. 3. The area surrounding the derrick floor is supported on steel piles similar to those used for the derrick pier. The elevation of the derrick floor is 30 ft. above mean low tide, but that of the rest of the island is 7 ft. lower. The base of the derrick is 24 ft. square, and its top is 169 ft. above the ocean floor.

The drilling rig consists of the standard rotary draw works and table, which are operated by gasoline engines. The mud used for circulation while the well is being driven is hauled out to the island in powdered form and is mixed with salt water to make the necessary drilling fluid. Pipe, sacked mud, cement, water and other supplies are stored on the platform. The men working on the well are transported back and forth by means of a launch, although a bunk house has been erected on the falsework that was used to drive the piles. This makes an extension of the main island platform and provides desirable facilities in case of storm.

The tanks used for mud and water storage during drilling will provide temporary storage for oil when the well comes in. Arrangements for transporting oil from the island to the shore probably will be decided after the well is proved, but the depth of water (32 ft. at low tide) will allow tankers to load directly from the platform. The amount of storage that can be supported by the island will have an influence as to whether this method or the use of a pipe line to the shore will be used.

Construction operations were carried out by the Robinson-Roberts Co., Los Angeles, Calif.

Concrete Strength Increased by Spray Irrigation

Tests made at Stony Gorge and Rodriguez dams show possibilities for producing higher-strength concrete by sprinkling—Spray system developed for Rodriguez Dam

By E. H. Burrows
Vice-President, Ambursen Dam Co.
New York, N. Y.

EXPERIMENTS made to determine the effect of sprinkling on concrete strengths at the Stony Gorge Dam near Orland, Calif., constructed for the United States Reclamation Bureau in 1928, and at the Rodriguez Dam, now under construction for the Mexican government near Tia Juana, Mexico, have shown clearly that a large increase in strength may be obtained through both occasional and continuous sprinkling to offset water losses due to high evaporation during the curing period. Both dams are of the Ambursen type, with buttresses supporting a slab deck.

The experiments for the Stony Gorge Dam were made by H. J. Gault, construction engineer for the United States Bureau of Reclamation. Representative of these tests are those made on six 6x12-in. cylinders having the following proportions:

Parts cement	1.0
Parts sand	1.52
Parts stone	2.78
Water-cement ratio	.79

These proportions were the same as those used for the deck or upstream face slab.

Three of these cylinders (marked *A* in Table I) were left in the molds for one day and then left outside without sprinkling for 27 days. With the exception of one day of light rain, these cylinders were exposed to the sun during that time. The remaining three cylinders (marked *B* in Table I) were left in molds one day and were then left outside during the same period that the *A* cylinders were exposed but were thoroughly wetted four times a day. Table I shows the results obtained when the cylinders were broken.

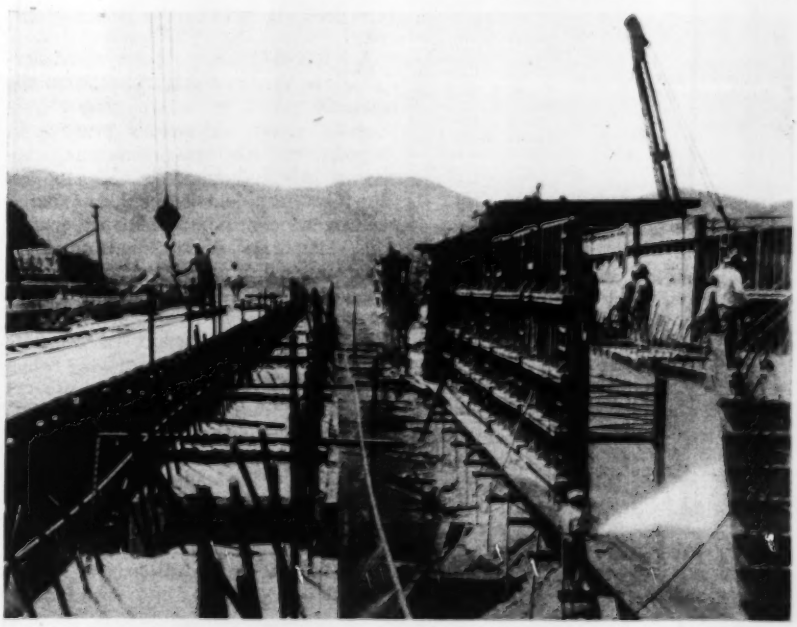
TABLE I — COMPARISON OF 28-DAY STRENGTH OF DRY AND SPRINKLED CONCRETE CYLINDERS, STONY GORGE DAM

A Cylinders, Dry	*B* Cylinders Sprinkled
2,315 lb. per sq.in.	3,360 lb. per sq.in.
1,945 lb. per sq.in.	2,830 lb. per sq.in.
2,420 lb. per sq.in.	3,570 lb. per sq.in.

These tests indicated that sprinkling increased the strength of the concrete in the Stony Gorge Dam by at least 45 per cent, as all concrete of the dam itself was also wetted down thoroughly four times a day after the forms were removed.

Somewhat more extensive tests to de-

During the stripping of forms (right) the concrete is kept wet by sprinkling with a hose. When stripping is completed (left), a line of pipe with spray heads is laid along each side of the buttress.



termine the effect on the curing of concrete of continuous sprinkling or irrigation were made at the Rodriguez Dam under the direction of Chas. P. Williams, consulting engineer for the Mexican government, and Francisco Gomez Perez, chief inspection engineer. For these tests 27 cylinders (8x16 in.) were made of concrete of the following proportions, which were used in the concrete for the buttresses:

Parts cement	1
Parts sand	2.61
Parts stone	5.40
Water-cement ratio	1.08

The cylinders were cured as follows: cylinders marked *C*, Table II, were left two days in the molds, after which, for nineteen days, they were stored in the open and were subjected to thorough and continuous spray irrigation. For the rest of the period they were stored in the laboratory and permitted to dry.

Cylinders marked *B*, Table II, were left two days in the molds, after which, for nineteen days, they were stored in the open and were thoroughly wetted four times daily as was the concrete at the Stony Gorge Dam. For the rest of the period they were stored in the laboratory and permitted to dry.

Cylinders marked *A*, Table II, were left two days in the molds, after which, for nineteen days, they were permitted to dry in the open, during which time no rain fell. For the remainder of the period they were stored in the laboratory under the same conditions as series *C* and *B*. All were designed to have a compressive 28-day strength of 2,000 lb. per sq.in., which was the specified strength of buttress concrete. The compressive strengths developed by these tests were as follows:

TABLE II — COMPARISON OF STRENGTH DRY AND SPRINKLED CONCRETE CYLINDERS, RODRIGUEZ DAM
(Strength in Lb. Per Sq.In.)

	C	*B*	*A*
Age: 28 days	2,195	1,887	1,668
	2,410	1,887	1,800
	2,410	1,930	1,887
Average	2,338	1,901	1,785
Per cent of designed strength	117	95	89
Relative strengths	131	106	100
Age: 60 days	2,610	2,405	2,210
	2,875	2,170	2,260
	2,830	2,635	2,310
Average	277,2	2,403	2,260
Per cent of designed strength	139	120	113
Relative strengths	123	106	100
Age: 90 days	2,940	2,394	2,260
	2,853	2,460	2,284
	2,853	2,435	2,260
Average	2,882	2,430	2,268
Per cent of designed strength	144	121	113
Relative strengths	127	107	100

The results of these tests, as of those at the Stony Gorge Dam, indicate the value of continuous irrigation during the period of the curing of concrete.

Sprinkling system for Rodriguez Dam

As a result of these tests it was decided to resort to sprinking the concrete in the Rodriguez Dam. The system adopted is novel and interesting both because of its effectiveness and its labor-saving possibilities.

High pressure and fine spray heads create a mist surrounding the fresh concrete.

Considerable experimentation was necessary to develop the most efficient and economical method of keeping the concrete wet during the entire 28-day period. The usual hand-sprinkling with hoses was attempted, but because of rapid evaporation and also because of the large amount of exposed concrete surfaces requiring wetting in an Ambursen-type dam, a force of twelve to fifteen men would have been required continuously to take care of this work. It was therefore determined to install a spray irrigation system, which offered an economical method of continuously wetting down the concrete.

The irrigation system is connected to the water supply provided to take care of the water and sewer systems for a camp housing about 1,000 persons. This supply is drawn from large storage tanks installed at an elevation of 400 ft. above the riverbed and has ample capacity for all the demands that are made upon it for sprinkling the concrete.

In view of the high pressure available both when pumping direct into the sprinkler system or when utilizing the gravity flow from the tanks, the standard type of sprinkler head such as is used for lawn irrigation was discarded and small spray heads such as are used in large vegetable markets for moistening garden produce were adapted to the requirements. These spray heads produced a very fine mist or vapor that was found admirably adapted to the requirements of the work.

About 1,800 ft. of ¾-in. galvanized pipe is used for the concrete sprinkling service. This pipe is drilled with ¼-in. holes on 4-ft. centers, tapped out to receive the ⅜-in. sprinkler spray heads. The day after any section of concrete is poured and before the forms are stripped a single line of this pipe is laid along the center of the top of the pour. Water from the spray heads in this pipe keeps the concrete thoroughly wetted until it is time to strip the forms. While the forms are being stripped the concrete is kept wetted down with a hose, and as soon as the forms have been removed from the concrete the single line of pipe is shifted to a point outside the top of the pour and a second line is laid along the other side of the top of the concrete. Water circulates freely under pressure through the entire piping system, and the resulting fine spray keeps the concrete thoroughly irrigated for the entire 28-day period without further manipulation.

In place of the fifteen men formerly needed to wet down the concrete with hoses only two men are required to attend to all of the pipe used in keeping the sprinkler heads clean, and the work is now much more efficiently done.

Cross-Connection Elimination Recommended by A.W.W.A.

AS AN expression of policy the American Water Works Association has recently gone on record through its committee on waterworks practice as opposed to new cross-connections between safe and unsafe water supplies. Further, it recommends that existing cross-connections be eliminated, except that temporary cross-connections may be continued in use if made through properly installed and adequately supervised, all-bronze, rubber-seated, double-check valves when approved by state health authorities, and then only when extraordinary circumstances prevent complete severance. At the discretion of these authorities the additional safeguard of proper disinfecting equipment for the private supplies should be provided.

In an 80-page report the committee on cross-connections, which has been at work since 1930, has set forth a most exhaustive review of the subject in all its phases. The recommendations have taken into account the U. S. Public Health regulations, which permit no certification unless cross-connections are absent or equipped with approved modern protective devices, and the policies of 43 states queried. Of these, thirteen prohibit entirely and nine permit protected cross-connections.

The objection of the fire-insurance interests to cross-connection elimination where there is deficiency of quantity is answered by a recommendation to correct such deficiencies. Bypasses around purification plants and emergency intakes are recommended to be eliminated as far as practicable and as rapidly as possible. Until this is done, it is urged that these menaces be safeguarded in a manner approved by the state and local health authorities.

The report further recommends that local pollution through improper plumbing be guarded against by nationally uniform provisions in plumbing codes, the association to help establish them.

Architecture Applied to Elevated Steel Tanks

First attempt to improve appearance of tanks and towers results in some structural innovations on Baltimore and Tallahassee installations

ELEVATED steel water tanks recently completed for the cities of Baltimore, Md., and Tallahassee, Fla., represent the first serious effort made to improve the appearance of these important and conspicuous elements of municipal water-supply systems. Previous activity in this field has usually taken the course of incasing the steel tower and tank in stone or brick. These new tanks, by virtue of some radical departures in structural make-up, achieve a distinctive architecture in the steel itself. Among the changes made from past practice are the substitution of welded plate columns for laced channels and rolled H-sections, the removal of diagonal rod bracing from the exterior panels of the towers or its elimination altogether, the use of solid instead of laced struts, an improvement in the appearance of balcony railings, the virtual elimination of all re-entrant angles both in the tower and tank and the use of dome roofs devoid of eaves. Both tanks are of the radial-cone-bottom type, as described in *Engineering News-Record*, Feb. 25, 1932, p. 279. Welding has played an important part in securing the results so far obtained, and much of the special fabrication has been confined to the shop, so that field work is not any more complicated than formerly.

Baltimore tank

The Baltimore tank has a capacity of 300,000 gal. and serves as a storage reservoir for one of the zones of the municipal water-supply system, this particular zone covering an area of about 2½ square miles and lying entirely outside the boundaries of the city, in the village of Towson, Md. The tank is located near the center of distribution in residential territory and replaces an old standpipe at the pumping station, about 1¼ miles away. The new tank is based upon the first-prize design in the competition sponsored two years ago by the Chicago Bridge & Iron Works, but the diameter of the tank (42 ft.) and the height (102 ft. from the ground to the overflow at the top of the tank shell) being somewhat greater than in the prize design, the actual installation is not an exact replica in appearance of the architectural sketches. The 30-ft. range of head is also somewhat greater than was contemplated in the prize design.

Examination of a view of the completed Baltimore tank (Fig. 2) reveals that the columns are the principal distinguishing feature, that solid section struts but no vertical diagonal bracing is used, and that the balcony is several feet below the bottom of the tank, serving as a strut between the columns rather than as a ring girder at the joint between the shell and bottom plates, as has usually been the case. The junction of the shell plates and dome roof is a smooth curve, and apron plates extend below the lower shell plate, between the columns, to hide the girders and trough plates of the radial-cone bottom.

The columns, of which there are ten, are completely without precedent in tank towers. Each is a steel plate box about 8 ft. deep radially and of a streamlined section, 1 ft. 8 in. wide at its outer edge and 1 ft. 3 in. wide at the inner edge. The columns were completely fabricated by arc-welding and hermetically sealed in the shop to eliminate possibility of corrosion. As shown in Fig. 3, each column consists of a half circle of ¼-in. plates and a vertical truss for the outer edge, ¼-in. side plates and a 15-in. channel for the inner edge. The chords of the vertical truss are 4x4x⅜ in. angles, while the Warren-type web system consists of a continuous ¾-in. square rod. The side plates are braced at about 5-ft. intervals by horizontal trusses similar in make-up to the vertical truss. In fabricating the columns one chord of the horizontal trusses was tack-welded to the side plate. When the other side plate was added, completely inclosing the column, tack-welding on the inside was not possible, and the other truss chord was fastened by means of plug welds made from the outside through holes in the side plate. At both top

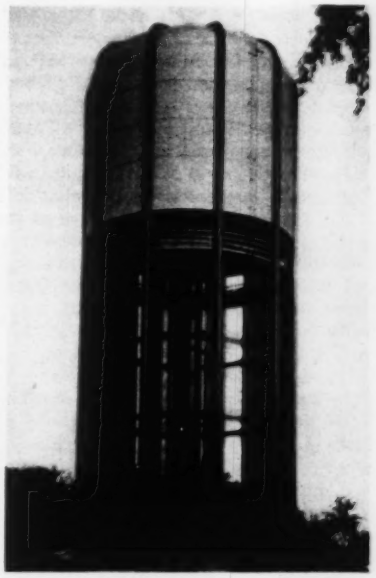


Fig. 2—Elevated tank of 300,000-gal. capacity for Baltimore County Metropolitan District. Columns are of steel-plate box section, welded and hermetically sealed in the shop. In the field the tower is braced by the balcony and by horizontal struts but is without X-bracing. Architectural ribs are welded to tank shell and roof.

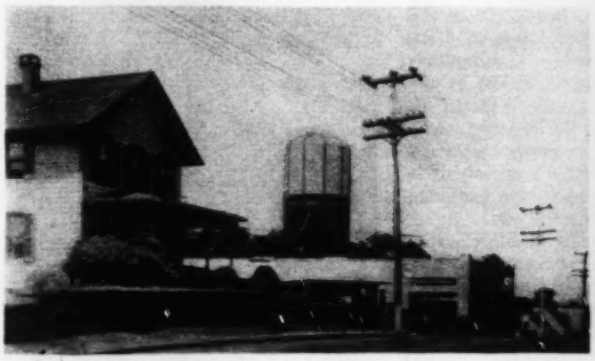


Fig. 1—Two notable examples of elevated steel-tank architecture. The Baltimore tank at the left is in a particularly conspicuous location on a hilltop. The Tallahassee, Fla., tank at the right is located in a high-class residential district.

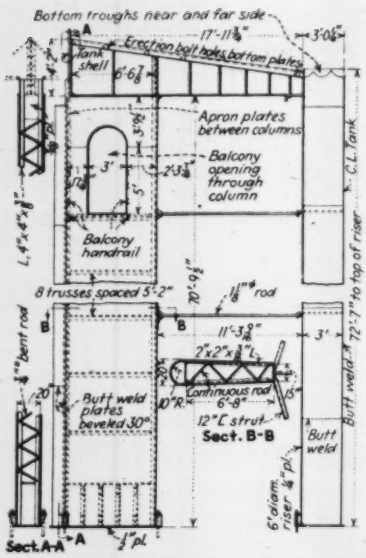


Fig. 3—Shop-welded columns, girders and riser comprise the tower of the new elevated tank for Baltimore, Md.

and bottom the side plates, vertical angles and channel are ground to bear on plates that close the ends of the columns. The half-circle nose of each column is continued up the tank shell and over the roof as an architectural expedient. It was welded to the shell in the field and to the roof plates in the shop.

With the exception of the columns and the miscellaneous items mentioned above, the tank does not differ materially from others of radial-cone-bottom design. The radial plate-girders rest on the columns at the outer end and on plate brackets welded to the riser pipe at the inner end. The lower chord of these girders is a 6x½-in. plate, and the upper chord is a 5x5x⅜-in. angle supplemented by the bottom trough plates, which sag between the girders and are welded to the top chord angle at its apex. The girders were completely shop-fabricated.

The struts between the columns are steel channels increased in width at the column connections by welded plates. Stiff and deep strut-to-column connections are necessary because there are no diagonal rods in the vertical panels. The shell plates of the tank were field-riveted. All other parts were electric-welded, coated rods being used. The distinctive appearance of the tank is enhanced by the final field-painting, in which aluminum paint was used for shell, roof and balcony hand-rail and a green graphite paint for the tower and the architectural ribs that extend up the tank shell from each column.

Tallahassee tank

In the Tallahassee tank also the columns represent the principal departure from precedent, being made of steel plate, although of cylindrical instead of box shape as at Baltimore. In addition, as contrasted with the Baltimore tank, the radial girders are not hidden by apron plates but are cantilevered beyond the columns and curved up at the outer ends, carrying the bottom trough plates, which they support, to a tangent connection with the tank shell. Another difference is that the lower 7 ft. of the dome roof of the Tallahassee tank is used for water storage. The balcony serves as a ring girder at the tank spring line (intersection of shell and bottom plates) instead of as a column strut as at Baltimore. No struts or rod bracing in the vertical plane are used between the columns on the Tallahassee tank. Instead, 24-in. plate-girder struts are placed between the radial girders on top of the columns, and four sets of interior rod X-bracing are used. These 1⅞-in. square rods run from the top of one post to the bottom of the second post from it, as shown in Figs. 5 and 6. The plan also shows the proposed scheme for landscaping at the base of the tank, which will include a mirror pool around the riser pipe, with a broad flight of steps leading up to a walk that encircles the pool.

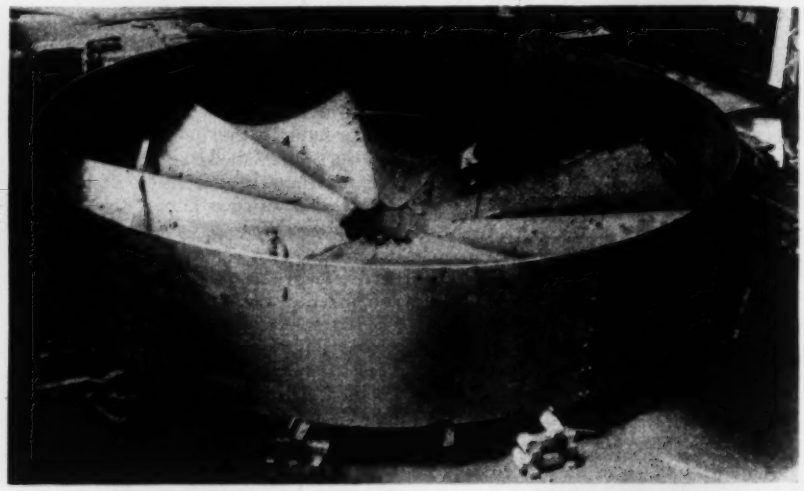


Fig. 4—Fitting up the radial-cone bottom of the Baltimore tank in the shop. Bottom plates sag between welded plate girders, which in the erected tank rest on the columns at their outer ends and on brackets on the riser pipe at their inner ends (Fig. 3).

The Tallahassee tank has a capacity of 400,000 gal., a diameter of 56 ft. and a 24-ft. range of head. It is 102 ft. high to the overflow line. A 4-ft.-diameter riser is used. The tank is situated in a residential section of the city where, according to William R. Galt, city manager of Tallahassee, some sort of distinctive structure was demanded by the property owners. The increased water storage now provided has been needed for some years, inasmuch as the supply is pumped from wells and peak demands were hard to meet. Tallahassee, with a population of 12,000 and an area of 4.2 sq. miles, has an average daily consumption of 835,000 gal. Reservoir storage capacity of 400,000 gal. is available at the pumping plant. With the new tank adding a like amount, storage is now practically equal to daily demand. Pumping can be confined to off-peak periods of demand. The tank is located about 1 mile from the pumping station. It serves the entire city.

As in the Baltimore tank, only the shell of the Tallahassee tank is riveted. Columns, riser, radial girders and struts were welded in the shop, while field-welding was used on the bottom plates and the tower rods. The columns are cylindrical, 33 in. in diameter by 76 ft. long, made up of ten rows of steel plates with joints butt-welded; they are ground smooth on the outside and reinforced on the inside as required. Reinforcing diaphragms are welded inside the columns at top and bottom, but not elsewhere. The columns are hermeti-

Fig. 5—Elevated tank of 400,000-gal. capacity at Tallahassee, Fla. The columns are 33-in.-diameter steel-plate cylinders of 76-ft. unsupported length with no internal stiffening diaphragms. Note that diagonal rods attach only to every other column.

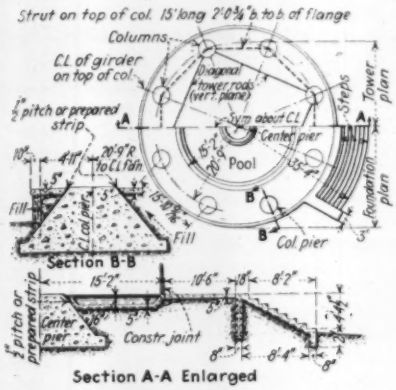


Fig. 6—Sketch plan of Tallahassee tank, showing landscape plan for the base and structural elements of the towers.

cally sealed in the shop after being painted inside with red lead. In large measure the design of the columns was empirical, being based upon an extensive series of tests that determined proper and safe ratios of column diameter to plate thickness.

On four of the columns, steel tower rod stubs were welded in the shop; the top stubs are 3 ft. long and the bottom stubs 4 ft. 2½ in. long. The remaining lengths of the rods are shop-fabricated units of crossbracing, and these were butt-welded to the stubs in the field. Inasmuch as these rods connect the top of one column with the bottom of the second column from it, they are not located in the vertical plane of adjacent columns. In addition to the bracing afforded by the rods, the tops of the columns are tied together by 24-in. I-beams (Fig. 5). Since there are no struts between the columns other than those at the top, the tower has a very open and slender appearance.

The shop-fabricated welded radial girders have a curved end that cantilevers 10 ft. beyond the columns (Fig. 5). The curved end being entirely outside the tank, supports the balcony which thus also serves to tie the ends of the girders together. The horizontal members of the balcony railing are a 7-in. base channel and a 3½x2½x¼-in. top angle. Vertical bars 2x½ in. are welded between the horizontal members. At each radial girder location an 8-in. channel post with back outward is provided in the railing. These posts are topped with welded knob finials.

Both tanks were designed, fabricated and erected by the Chicago Bridge & Iron Works.

Triangulating the Continent of North America

Precise surveys of the United States, begun in 1816, have been extended into Canada and Mexico and now form a series of triangle chains 46,000 miles long all referenced to Meades Ranch Station in Kansas

By William Bowie
Chief, Division of Geodesy, U. S. Coast and Geodetic Survey, Washington, D. C.

NEARLY 117 years ago the first geodetic triangles in the United States were established near Fire Island Inlet, Long Island, N. Y. The geodetic control system thus began by Ferdinand Hassler, first head of the Coast Survey, has since been extended over the United States and into Canada and Mexico, forming a great unified network of chains and triangles, including about 46,000 miles of chains or nearly enough to lap twice around the world.

Supplementing this net of first-order triangulation are arcs along our entire coast lines, in the bays, harbors and tidal rivers, executed by the Coast and Geodetic Survey and the Corps of Engineers, U. S. Army, and also much triangulation of the third order in the interior of the country made by the engineers of the U. S. Geological Survey as a part of its topographical surveying. In addition, there are many thousands of miles of lines of traverse by various federal agencies. Triangulation has also been made over a number of cities by their engineering departments. Supplementing this system of horizontal control is a 75,000-mile system of high-grade leveling for vertical reference.

This array of triangulation and traverse, all of which may be designated as horizontal control surveys, is a national asset of primary importance.

The earliest triangulation in this country was designed to serve the charting of coastal waters by giving accurate latitudes, longitudes, distances and directions to the topographic and hydrographic engineers engaged in making the charts needed by the navigator. The triangulation necessarily had to extend inland in order to connect the charts of the Atlantic, Gulf and Pacific coasts, and the inland triangulation was found to be of such value to many interests that Congress directed that arcs should be extended in all directions through the interior of the country, in order to furnish the bases for state, county, city and other surveying and mapping projects.

The lengths of the sides of the triangles of the first-order net are functions of the terrain. Where the area is flat and heavily wooded, the sides vary in length from 5 to 12 miles. In rolling country, not heavily wooded, the lines vary from 5 to 20 miles, while in the mountainous areas the majority of the lines reach a maximum of about 40 miles, although the longest line in the network joining Mt. Shasta and Mt. St. Helena in California is 181 miles. In recent years the lengths of lines have been shortened materially, making more stations per unit of area available for mapping and other engineering purposes.

Unifying the System—In 1900 the Coast and Geodetic Survey adopted a station called Meades Ranch, in central Kansas, as the initial station for the whole triangulation net of the country, and soon all of the triangulation then existing was brought together into a single net. In 1913 the organizations having charge of the geodetic work of Canada and of Mexico also adopted Meades Ranch as the initial point for their systems of triangulation. Had Canada and Mexico adopted initial points of their own, there would have been overlaps, gaps and offsets in the surveying data at the international boundaries. It is impossible to select

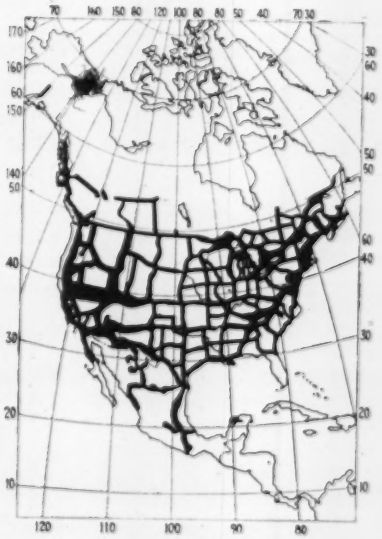


Fig. 1—Triangulation chains, here shown black because many of the individual triangles would be too small to show, gridiron the United States. Unified adjustment of the Canadian, United States and Mexican networks has been carried out, giving accurate relative locations of points in all three countries. Extension of the Canadian network to Alaska will make it possible to tie up with the European system across Bering Strait. Ultimately connection with the South American arcs will be established. All true map work and all property surveys depend on the fixed bases supplied by the points of this network.

a point in one country, based on triangulation and astronomical observations in that country, that will be properly correlated with the initial station similarly determined in an adjoining country. The inevitable errors of physical measurement would produce differences, perhaps hundreds of feet or only a few feet, where the triangulations of the two countries joined at the boundary. All of this trouble has been eliminated from the triangulation nets of North America. One can compute distances from any triangulation station in the United States to any point of the triangulation net of Canada or of Mexico with extreme accuracy because the nets form a single unit.

North America is the only continent in the world having a unified triangulation system. In the United States there are now about 36,000 miles of arcs of chains of triangles, while in Canada there are 7,000 miles and in Mexico 3,000 miles. The triangulation has been extended into Canada to latitude approximately 55 deg., while in Mexico it has been carried to the Guatemalan border. A chain of triangles has been extended from the vicinity of Point Roberts, the western limit of the 49th parallel boundary between Canada and the United States, along the shores of British Columbia and through southeastern Alaska to White Pass at the head of Lynn Canal.

It is hoped that in the next decade the chain of triangles can be extended into northwestern Canada and then down the Yukon River to where that river crosses the 141st meridian. From there it should be carried over Alaska to furnish the basis for various surveying and mapping operations. It is not beyond the possibilities that this work can be carried to the western shore of Bering Strait, from where triangulation could be extended to the eastern shore of Siberia. There are islands in the strait that should make it possible to have a system of triangles that would carry the latitudes, longitudes and azimuths from one continent to the other.

Already triangulation has been carried over a large part of Europe, and it is probable that in the not very distant future this triangulation will be extended eastward across Asia to Bering Strait. When this has been done and a connection has been made with the triangulation net of North America, it will be possible to use the data for the two hemispheres in determining the shape and size of the earth and the deviations of the sea-level surface, or geoid, from the spheroid, or regular mathematical surface. The triangulation of Africa is joined with that of Europe.

It is hoped that later triangulation will be extended southward from Mexico, through the Central American countries, and along the Isthmus of Panama to South America. Each of a number of countries of South America has some triangulation, and eventually the various arcs will all be connected together.

In 1924 a new method was devised at the office of the Coast and Geodetic Survey to make an adjustment of a large network of arcs or chains of triangles. Such an adjustment was necessary for the United States, because in fitting the new arcs into the adjusted ones the new work had been forced to make all of the corrections necessary to close the loops formed by the arcs. The method proved to be very effective and made is possible to have the 26,000 miles of triangulation

Fig. 2 — Arc of first-order triangulation along the coast of California, which controls all of the subsidiary triangulation in that area.

then, or shortly thereafter, existing in this country adjusted together. The results have given a very strong net that can be held fixed. The adjustment included several thousand miles of triangulation in Quebec and Ontario.

Undoubtedly, the triangulation nets of the three countries of the western hemisphere are national assets of great value to each of them, and the value is greatly increased because of the unification of the nets. There is nothing more important in the life of a people than to have the dividing lines of public and private property well defined and accurately located; and, if the monuments that mark these lines are tied in to the triangulation net, then location can at any time be recovered even though the monuments have disintegrated.

In the U. S. network each of the ground stations is marked by a heavy block of concrete or by outcropping rock, into which is set an inscribed bronze tablet. Where feasible an underground mark is established, which can replace the surface monument should the latter be disturbed. Near each station are set two reference marks whose distances and bearings from the station are accurately determined. There is also an azimuth mark placed about a quarter of a mile from the station, and it can be seen from the ground at the station. The azimuth to this mark is determined with great accuracy for use by engineers in starting their traverses. The engineer has, therefore, in each station a fixed position and an accurate azimuth and at a reasonable distance another station on which he can check his traverse for position and azimuth.

No doubt the engineers of cities, counties and states and those in private practice will adopt plane coordinates for the triangulation and traverse stations for by so doing the office work involved will be greatly reduced. There necessarily will have to be a restriction of the distance in the east and west directions from the central meridian for each plane coordinate system in order to keep the distortion, due to the earth's curvature, within an allowable maximum. However, the length of a triangle side is determined with an accuracy of about 1 part in 100,000, so that the position of a triangulation station is fixed with relation to adjoining stations within about 6 in. where the lines are 10 miles or so in length. This is sufficiently accurate for all usual engineering purposes. A further aid to engineering work lies in the fact that as the triangulation is extended across a state, connections are made to state and county boundary monuments, stations of traverse and third-order triangulation used for topographic mapping and traverse stations of the state highway commission. The positions of all well-defined and prominent objects, such as radio towers, church spires, cupolas, water towers and stacks, are also determined and recorded for reference.

In recent years engineers of the U. S. General Land Office have accompanied the triangulation parties for the purpose of recovering section corners that are tied into the triangulation net. This plan cannot always be followed because of the scarcity of funds that may be devoted to the purpose. The surveying of public lands for settlement had to go ahead of the triangulation, but it is reasonably certain that eventually all boundaries of public and private land will be tied into the national triangulation net.

In the next eight or ten years the main network of triangulation for this country will be completed. Then there will be few or no places in the United States more than about 25 miles from a triangulation station. Intermediate areas can readily be filled in by subsidiary triangulation and traverse by the engineers engaged on detailed surveying and mapping or on other engineering operations.

Much control survey information, now in the archives of the Coast and Geodetic Survey, awaits publication. Pending publication, an engineer can secure copies of the manuscript data, in many instances without cost to him, by writing to the director of the United States Coast and Geodetic Survey, Washington, D. C.

Eight Years' Upkeep Costs of Surface-Treated Gravel

Maintenance cost records of surface-treated gravel in Caddo Parish, La., show average annual expenditure, from 1925 to 1932, of $106 to $122

By J. T. Bullen
Highway Engineer, Caddo Parish, Shreveport, La.

THE WIDE popularity of the low-cost types of road surfacing has aroused much discussion with regard to construction costs, maintenance costs and annual costs of such surfaces as contrasted with the so-called high-type pavements. The advocates of the latter type have contended that, while the first cost of construction was materially higher, the reduced maintenance was such an important factor as to outweigh the lower first cost on the low-cost types. It has been difficult to obtain accurate maintenance figures on the several types of road construction, chiefly because of the unfortunate cost-accounting methods employed by different state highway departments, which have in times past included betterments under maintenance figures. The following example cited in Louisiana is, therefore, of interest in showing the exact cost of one variety of low-cost surfaces, i.e., surface treatments. As it is also difficult to obtain photographs showing original construction and present condition in exactly the same place, the photographs shown are of further interest in this connection.

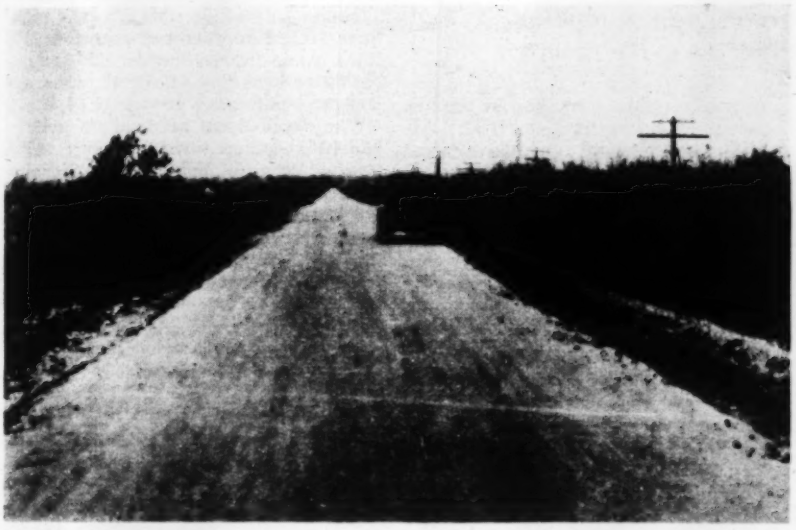


Fig. 1 (above)—Road as of 1925, with 8-in. gravel surfacing, located near Arkansas line in Caddo Parish in Louisiana.

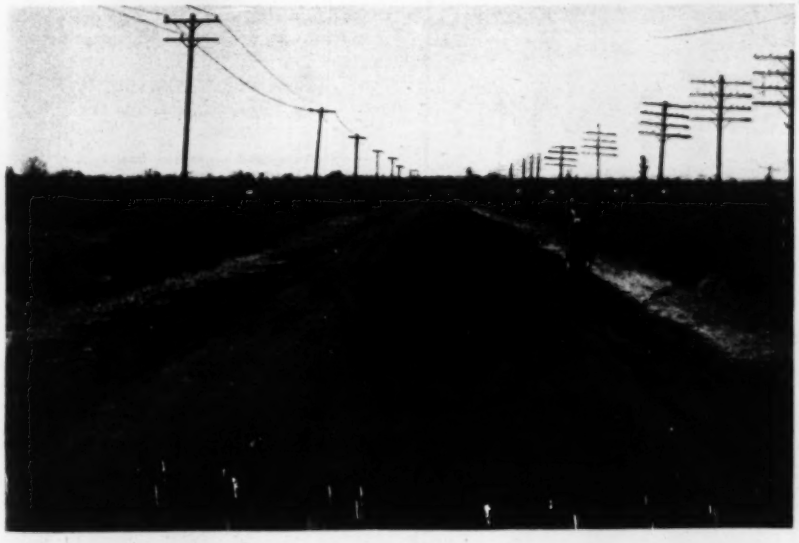


Fig. 2 (below)—Identical view after adding gravel and double surface treatment in 1922 and maintaining for ten years.

The figures here given refer to sections of road built in Caddo Parish, La., something over ten years ago. Originally the road surface had been constructed from pit-run gravel, and by 1920 the consolidated thickness of its surface was approximately 3 in. At that time 4 in. of iron-ore pebble gravel was added to this surface and spread and manipulated with a road grader until consolidated. In 1922 test holes showed a total depth of 6 in. of gravel. An additional 3½ in. (loose depth) of pit-run gravel was then added and consolidated by blading, so that a final total compacted thickness of some 8 to 9 in. was obtained. The road was next surface-treated with a soft hot asphalt cement at a cost of 6.4c. per square yard for a width of 14 ft.—a total cost of $583 per mile. A year later a second application was made at the cost of 4c. per square yard, or for the two years a total of 10.4c. per square yard, amounting to $945 per mile. The rates of application were approximately ⅓ and ½ gal., respectively. The cover coat consisted of coarse sand. No additional treatment has been given this surface to date, a period of more than nine years.

Accurate maintenance costs per mile were not kept until the beginning of 1925, since which time they have been as follows:

1925.....	$78.30	1929.....	$146.16
1926.....	139.70	1930.....	79.49
1927.....	198.54	1931.....	119.31
1928.....	108.75	1932.....	109.40

This is an average of $122.46 per mile per year.

Figs. 1 and 2 show the road at the time of construction and in 1932 respectively. Because of the relatively narrow width there is some difficulty in keeping the shoulders in good condition and, as there is considerable oil-field traffic on this road, there is a marked tendency to cut at the edge, which would be largely eliminated provided the surface had been treated to a greater width.

A few miles farther north the old road had been constructed about as outlined above, except for the use of both pit-run and crushed gravel, and had approximately the same depth of surface when it was treated in 1922 for a width of 14 ft. with ⅓ gal. per square yard of hot asphalt cement at a cost of 4.7c. per square yard. A year later in 1923 it was given a second treatment at a cost of 4c. per square yard, using ½ gal. of hot asphalt. No treatments have been given since that time. Maintenance costs per mile were not available prior

to 1925, but since that date accurate figures have been kept as follows:

1925.....	$114.66	1929.....	$136.44
1926.....	84.52	1930.....	75.14
1927.....	213.20	1931.....	73.67
1928.....	79.38	1932.....	72.25

This is an average cost of $106.16 per mile per year.

The sections are on Route U. S. 71, built and surface-treated as a parish road and recently taken over as a part of the state highway system. Traffic volume comes within the normal range of surface treatments, being between 400 and 800 vehicles daily, with peak loadings somewhat above these figures under special conditions. A considerable portion of the traffic is the hauling of oil-field supplies, an extremely damaging type of traffic due to the heavy concentrated loads. The important maintenance facts brought out are:

1. There is a high supporting value in a gravel surface which has been carefully consolidated and stabilized prior to surface treatment.

2. The value of durability and waterproofing qualities developed by a double surface treatment of hot asphalt on such a well-stabilized base far exceeds the cost.

3. A surface-treated road constructed with due regard for stability and proper cross-section prior to surface treatment is justified by the low-cost of maintenance.

4. It is desirable to make surface treatments of sufficient width to prevent traffic going over the edges. This would probably reduce maintenance costs even below the low figures shown in the preceding tables.

Increasing the Capacity of Framed Timber Joints

Special metal connectors, used extensively in Europe on large timber structures, are proposed for use in this country

By F. O. Dufour

Consulting Engineer, Philadelphia, and Member, National Committee on Wood Utilization

AN ENGINEERING REPORT, "Modern Connectors for Timber Construction," has just been issued by the National Committee on Wood Utilization, U. S. Department of Commerce, and the Forest Products Laboratory, U. S. Department of Agriculture. Representing years of research by governmental agencies in both Europe and the United States, it offers a wide departure in construction methods and describes in detail the new timber-jointing methods discussed in this article.

The report prepared by Nelson S. Perkins, construction engineer, Peter Landsem, assistant construction engineer, and George W. Trayer, senior engineer, of the Forest Products Laboratory, may be obtained at a cost of 15c. from the Superintendent of Documents, Washington, D. C.—EDITOR.

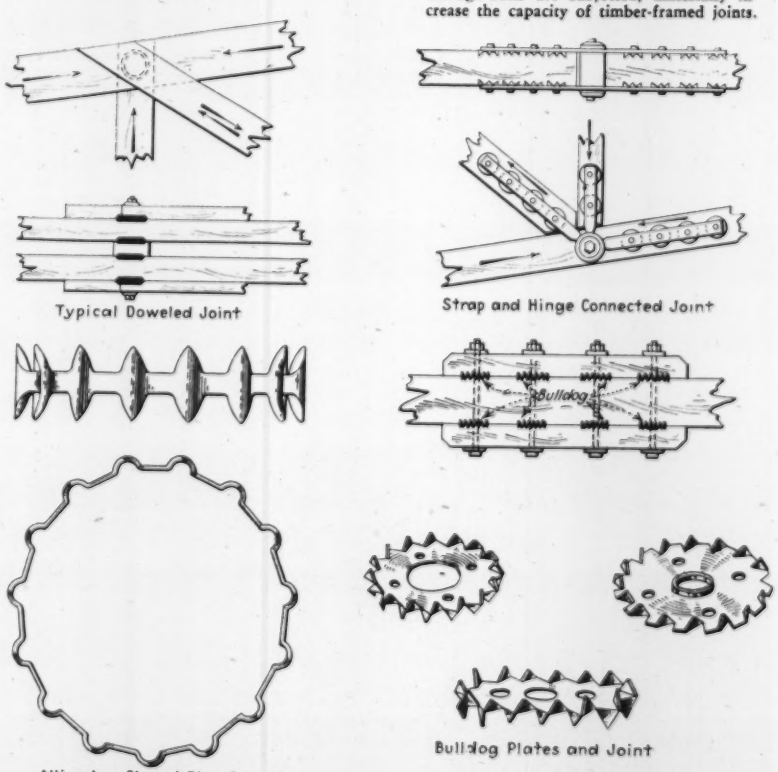
WOOD CONSTRUCTION is raised to a new standard of engineering precision through the introduction of an improved system of timber jointing that increases severalfold the capacity of the ordinary bolted joint, adds to the rigidity of structures, permits marked savings in both lumber and hardware and encourages the prefabrication of wood-framed units, advantages that should stimulate the use of wood as a structural material.

This new system involves the employment of various types of connectors, consisting of rings, plates and disks—some toothed and some plain—which are inserted in the faces of wood members that are to be joined and through the center of which a connecting bolt is placed to serve the secondary function of binding the joints together, the connectors themselves acting to transfer the load from one member to another.

These connectors were developed by European engineers during the closing periods of the World War and the ensuing years of reconstruction, when economic conditions revived an interest in wood as a structural material. Attention was focused on the weakest link, the joint, and especially the bolted joint, in which it was recognized that the bearing stresses in the wood were not uniform along the bolt, as is commonly assumed, but were in effect concentrated near the edges or faces of the timbers. To mitigate this condition, various bushings, half-dowels and true dowels were inserted in the high-stress zones in the faces of the timbers, and gradually there evolved the modern timber connectors that replace the bolt as the principal load-transmitting agency. The efficiency of these connectors has been demonstrated in hundreds of European structures, including all-wood radio towers 525 ft. high, three-hinged roof arches spanning 250 ft., a wood-framed auditorium seating 75,000 persons and scores of other important buildings.

The development of these connectors had been followed with interest for a number of years by Axel H. Oxholm, director, National Committee on Wood Utilization, who had learned of them during several European trips. All

Fig. 1—Typical metal connectors, whose function is to provide increased bearing resistance on the face of timber members and to reduce the bending to which the through-bolts are subjected, materially increase the capacity of timber-framed joints.



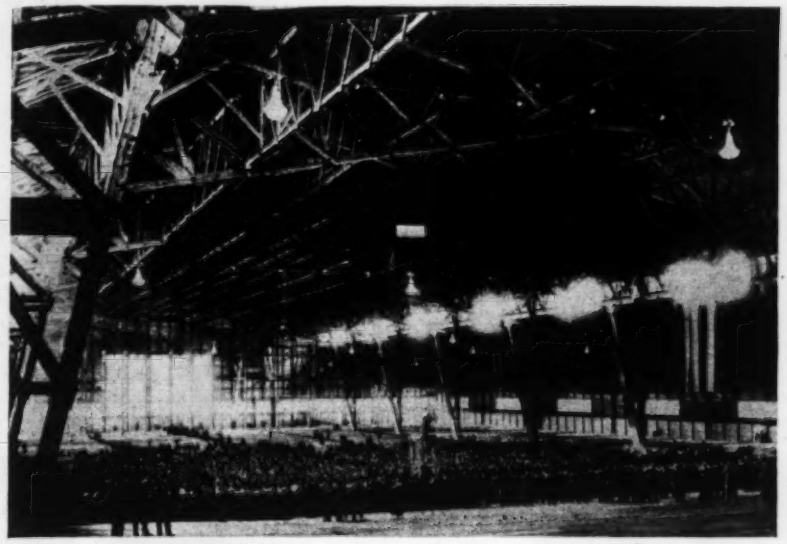


Fig. 2—Use of ring dowels in all joints of the three-hinged arch framing made this large timber auditorium in Vienna practicable.

available literature and test data on the subject were secured and studied by the engineering staff of the committee. Meanwhile several thousand samples of eight important representative types of connectors were obtained from abroad and furnished the Forest Products Laboratory, which undertook a comprehensive series of tests on them as applied to American construction woods. The results of these studies and research are presented in a report, "Modern Connectors for Timber Construction," just issued by the federal government.

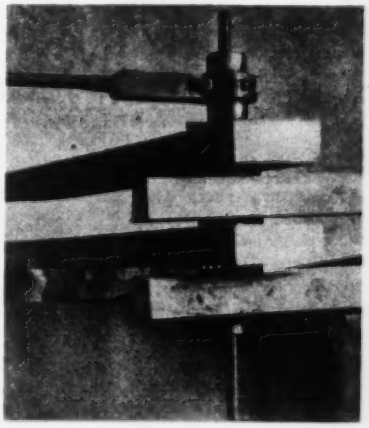
Of the 60-odd connectors described in the report, those selected for tests are illustrated in Fig. 1. The increased capacity obtained by using new devices instead of bolts may be shown by a few typical examples.

According to latest design practice ("The Bearing Strength of Wood Under Bolts," by Geo. W. Trayer, U. S. Department of Agriculture, Technical Bulletin 332, 1932) a tension splice, to develop a load of 30,000 lb., using a 1,200-lb. grade of timber, will require eighteen 1-in. bolts with nuts and washers, weighing in all 57 lb. The size of the main timber will be 4 x 10 in., with 2 x 10-in. side plates. With connectors, however, this same joint may be made with six pairs of 6¼-in. "alligator-toothed" rings and six 1-in. bolts, weighing in all only 21½ lb.; and the main timber need be only 4 x 8 in. There is effected a saving of more than 60 per cent in the hardware and of 20 per cent in the lumber.

Next, assume a joint in which a vertical frames in between two horizontals, all of the members being 3 x 6 in. Four ½-in. bolts can be placed in this joint, giving a bearing capacity of 2,400 lb. and a weight of 7 lb. If connectors are used, a capacity of 5,100 lb. can be developed with two 4½-in. "alligator" rings, weighing about 2 lb., and a capacity of 5,625 lb. with two 4-in. "bulldog" plates. By using still another type of connector, the Locher split ring, a capacity of 9,200 lb. may be developed with this same joint. The selection of the most efficient type of connector would depend upon the expected load and also upon the length of the vertical, if a compression member, because of stress limitations due to its column action.

A third type of joint (Fig. 1, right) may be used when all the members are solid timbers. With the strap-and-hinge connector, especially adapted to this type of joint, the load is transmitted from the timber to circular claw plates embedded flush with the wood, thence through protruding hubs to steel straps, and finally to the central hinge. Two connectors are used, one on each side of the joint; they are held together by ½-in. bolts through the claw plates. Each pair of claw plates has a recommended working capacity of 6,400 lb., and accordingly the tension diagonal can transmit 4 × 6,400, or 25,600 lb.; the chord can transmit a like amount, and the vertical, with only two claw plates, will have only half this capacity. The sizes of the straps may be varied to engage from one to six claw plates, depending on the load requirements. In European practice the maximum design capacity of the largest size hinge

Fig. 4—Pressing "alligator-toothed" ring connectors into wood members by means of a ratchet wrench.



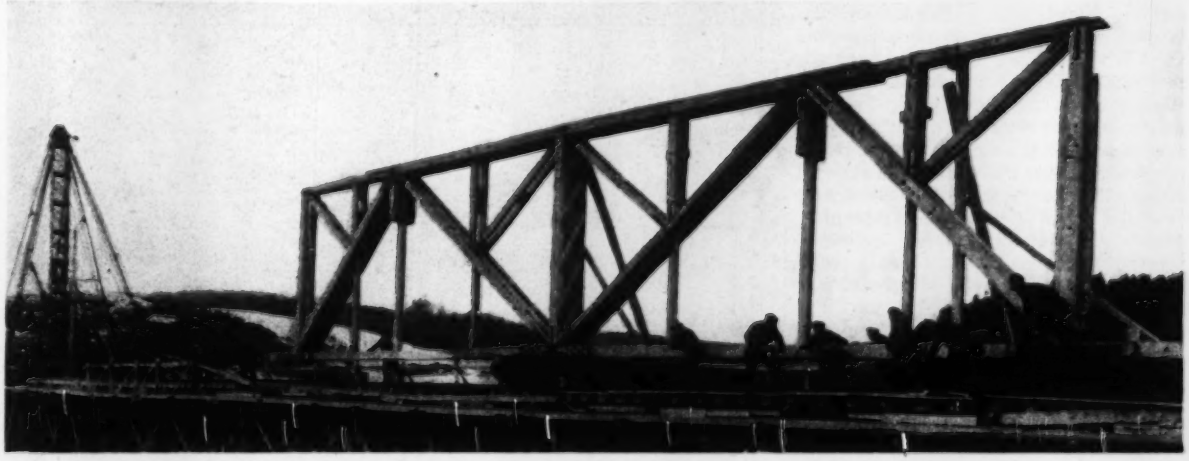


Fig. 3—Strap-and-hinge joint connectors, which transit either tension or compression, were utilized to assemble these trusses for a concreting trestle used on the Bleiloch Dam in Germany.

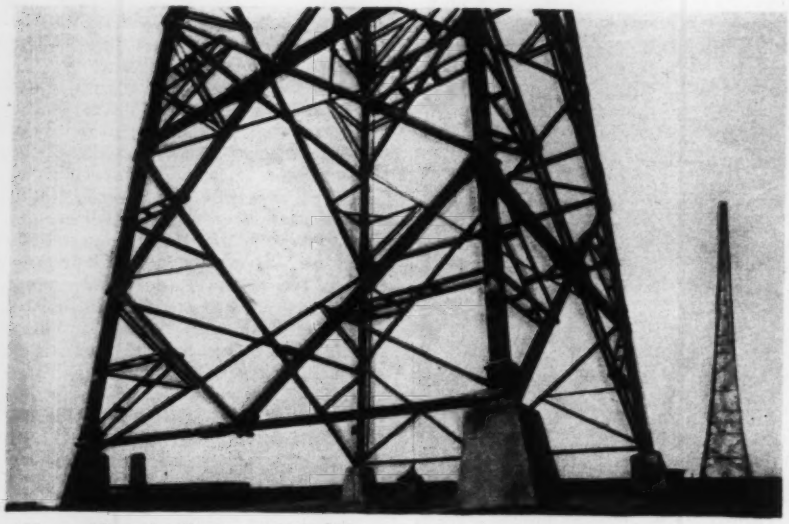


Fig. 3—All-wood radio towers 330 ft. high at Muhlacker, Germany, in which dowel-type connectors were used. Two similar towers 462 ft. high were completed at Breslau in 1932.

connectors is taken as 61,600 lb. The difficulty, if not impossibility, of framing such tension diagonals by means of the ordinary bolt is well known.

In addition to the increased joint capacity, just illustrated, the use of the connectors adds considerably to the rigidity of structures. This has been fully substantiated by the tests at the Forest Products Laboratory, where the slip of joints under loads approximating those recommended for design averaged about 0.02 in. With bolted joints it is common practice to bore the holes ⅛ in. larger than the bolt diameter, causing an initial slip of about 0.06 in., with more to follow as load is applied. Another feature of the new connector systems is their adaptability to prefabrication of wood-framed structural units.

The seating of certain types of connectors, such as the split rings and disks, requires the routing out of ring grooves or shallow seats. This is a simple process, however, which may be performed as in European practice by means of power-driven equipment. Toothed dowels, such as the "alligator" ring and the "bulldog" plate, are simply placed in position between the timbers using the bolt hole as a center guide. The joint is then squeezed together with a press or some form of jacking device. In Europe special high-strength assembly bolts are used with success; they are replaced later with ordinary bolts. In this country it is believed that an apparatus similar to the hydraulic tie-squeezer might prove advantageous in pressing toothed connectors into the wood members. These toothed conectors are suitable for either shop or field fabrication, whereas those requiring pre-cut grooves find their best application in structural units manufactured and assembled in the shop.

New City Hall and Esplanade Added to St. Paul Civic Center

Extensive improvements along the Mississippi River include a new city hall and court house, a new federal building and the widening of Third St. to form Kellogg Boulevard

By George H. Herrold
Managing Director, City Planning Board, St. Paul, Minn.

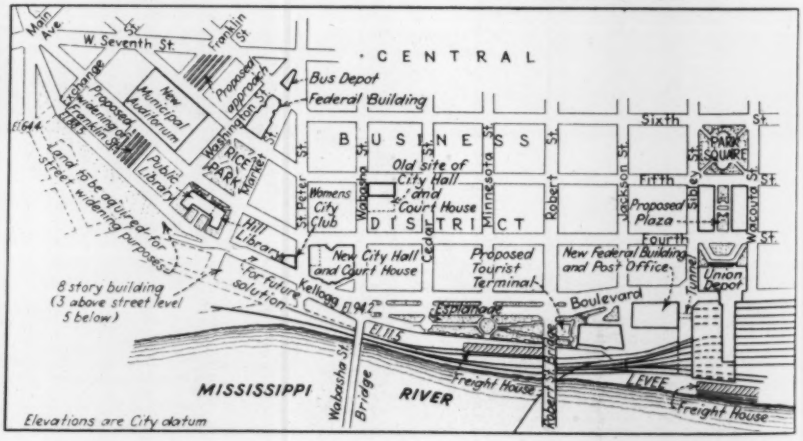
LATE in December, St. Paul, Minn., dedicated with appropriate ceremonies its new civic building and riverfront esplanade. At the same time, historic Third St., widened from its original width of 53 ft. to a broad boulevard by the clearing of all buildings on the river side, was renamed Kellogg Boulevard in honor of Frank B. Kellogg, long a resident of St. Paul. These events marked the culmination of planning begun in 1920 and realized in 1928, when the citizens of St. Paul approved a $16,000,000 improvement program by a vote that carried in every precinct in the city. Construction of a new city and county building was included in that program.

The civic center along the riverfront now includes the $15,000,000 Union Depot housing 23 lines of nine railroad companies, the public library, the Hill reference library and a beautiful bridge to Daytons Bluff built at a cost of $848,000, the Women's City Club and the new $3,000,000 federal building and post office. A tourist information and terminal building of impressive architecture also is planned for this new riverfront thoroughfare, and ultimately Franklin St. is to be widened to a battery of driveways between Third and Fourth Sts. so that the new municipal auditorium will also have a facing on Third St.

City and county building

The state legislature of 1929 set up the machinery by which a new city and county building could be planned, built and furnished by an advisory building commission of nine members: two from the city council (one being the mayor, ex-officio chairman of the commission), two from the board of county commissioners and five citizens holding no public office. The legislative act provided

Fig. 1—The riverfront area at St. Paul is being converted into a civic center served by a wide boulevard along the edge of the high ground overlooking the river.



that the building should be erected on the old site or on a new site not more than a block away. This provision was included in the act at the request of the Ramsey County legislative delegation, as both lawyers and the managers of office buildings in the city did not want the location changed. On the other hand, civic-minded citizens had a vision of a civic building facing on a new Third St. and the river, rather than one on the old site on Fourth St. completely surrounded by hotels and office buildings.

The great cost of housing all departments of the city and county in rented offices, and especially the difficulty of obtaining vault space for records during the two-year period required to tear down the old city and county building and build a new one, was the deciding factor in selecting the new site on Third St.

With the decision to erect the building on a new site, the old site was advertised for sale with certain protective restrictions as to future developments into office building and retail stores prior to Jan. 1, 1935. It brought $700,000, including $250,000 cash bond for fulfillment of contract. One-quarter of the block, 150x150 ft., immediately was sold to the Northern State Power Co., and that company has since erected a six-story office building, 75x150 ft., on the corner of Fifth and Wabasha Sts., an unoccupied section of the grounds of the old city hall. The new building clears the old building by 12 ft.

Through condemnation proceedings the block diagonally across from the old site fronting on Third St. was acquired for $510,000, and the buildings on it were razed immediately. The contract for the new building was let in June, 1930, and pouring of foundation concrete began on July 27, 1930.

The new building is 261 ft. high, twenty stories and basement. The ground floor, one story in height, covers practically the entire block, after widening Wabasha and Fourth Sts. for an unsymmetrical 56-ft. roadway and 17-ft. sidewalk. The second and third stories each are set back, and above that is a rectangular tower. The three lower floors are of reinforced-concrete frame, and the tower is of steel-frame construction.

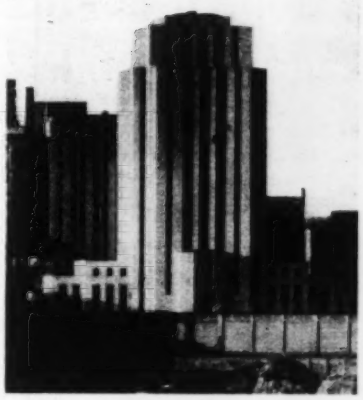


Fig. 2—The new city and county building of St. Paul as seen from across the river.

In planning the building for joint use by executive and administrative offices and by courts of the city and county, special attention was given to the matter of accessibility. On the first floor are the offices having most to do with the public, such as registrar of titles, county auditor, assessor and treasurer, municipal bank, city treasurer, comptroller and registration commissioner. On the second floor are the departments of public works, public utilities, valuation and assessment, city planning, purchasing agent and civil service, and on the third floor are the council chambers, mayor's office, city clerk, county commissioners, city and county attorneys, county surveyor, etc.

The layout of the tower was arranged with special attention to court requirements, provision being made for four district courts on each floor with judges' chambers, jury room and court reporters for each. Sixteen courts in all are provided for. However, they are placed in upper floors of the tower. The fourth floor, the first in tower, is occupied by the department of parks, playgrounds and public buildings, including the city architect's department. The fifth floor is left unfinished for expansion, and the sixth and seventh floors are given over to the education and allied departments.

The municipal reference library and law library are located on the 18th floor. The 19th, 20th and 21st floors are used for storage, water tank and elevator machinery. Three floors are unfinished, and unfinished rooms on other floors provide for future expansion, change in form of government, etc.

A battery of six elevators serves the building. A special elevator is provided to take prisoners from the tunnel connecting the new building with the county jail to the courtrooms on the upper floors of the tower.

The total cost of the building, including land and furnishings, was $3,850,000, $700,000 of which was obtained through the sale of the old site.

The exterior finish of the building is Indiana limestone with black marble at the street level and Tennessee marble for window bases. The foyer and the main entrance is three stories in height with columns of blue Belgian marble having recessed lights set in the columns.

Architects of the new city hall and court house were Ellerbe & Co., St. Paul, with Holabird & Root, Chicago, as associates. Contract for the building was let to Foley Bros., Inc., St. Paul, in June, 1930.

Fig. 3—An airplane view of the riverfront area in St. Paul, with the new city-county building and new federal post office sketched in. The principal sections of the civic center shown are: (A) New City Hall and Court House; (B) park area between Kellogg Boulevard and the river, with Second St. under the park and open to the river; (C) First National Bank Building; (D) federal post office.

New Use for Sewage Byproduct Found in England

As a result of joint experiments carried out in England by engineers of the Bradford Corp. sewage department and the city gas department, a process has been developed to enable stocks of grease accumulated at the sewage-works to be used at the gasworks for enriching water gas generated in the usual manner. Bradford is the center of the wool industry, and the effluent from the local factories is the source of the grease. At present the gas department uses kerosene for the enrichment of water gas, but an order has now been placed with the sewage department for 400 tons of the treated grease, which will enable purchases of kerosene from abroad to be reduced.

New Rail Section Adopted by A.R.E.A. at Chicago

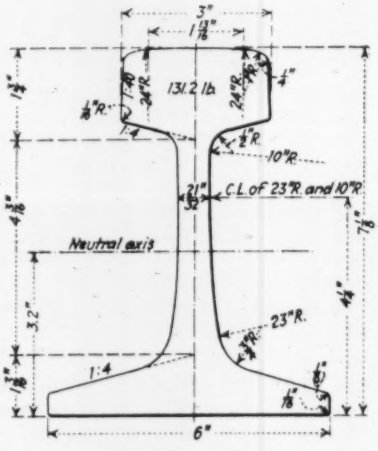
ADOPTION of a new 131-lb. rail section, identical with that which the Pennsylvania Railroad developed in 1931, and the withdrawal of the present 120-, 130-, 140- and 150-lb. A.R.E.A. rail sections were the most important actions taken at the recent convention of the American Railway Engineering Association. Brief reference to that action was made in the report of the convention published in our issue of March 23, but in view of the importance of this action it appears desirable to give more information as to the reason for it. The explanation will be found in the following abstract of the rail committee's report on the subject.

"In its 1915 report your committee presented sections for rails weighing 100, 110, 120, 130 and 140 lb. per yard, with the comment that, in arriving at the sections submitted, there had been some compromises in our efforts to reach a recommendation for a single type of standard. The 100-, 110- and 120-lb. sections were adopted as standard that year. In 1920 the 130- and 140-lb. sections were adopted. In 1924 the 150-lb. section was adopted, far in advance of any demand for rail of so heavy a section. A number of railroads have used the 100-, 110- and 130-lb. sections, and a considerable tonnage is in track. No rail has ever been rolled to the 120-, 140- and 150-lb. sections.

"At the time these sections were first submitted in 1915 there was controversy between those who advocated a rail with deep head and those who favored a rail with a shallow head. The use of the deepheaded rail permitted a greater head wear but sacrificed height and consequently vertical strength and stiffness of the rail, as well as of the joint bar. The P. S. sections of the Pennsylvania Railroad were representative of this type. The advantages to be gained by the use of the shallow-headed rail are offset only by less area of head offered for wear. The Dudley sections of the New York Central were representative of this type. In order to obtain an agreement on a rail section, it was at that time necessary to adopt a compromise between these two types, but this did not produce the best that could be obtained from a given amount of metal. As might have been expected, neither the Pennsylvania nor the New York Central, which roads use the largest tonnage of rail of any of the railroads, have used these A.R.E.A. sections, and to that extent they failed to become standard.

"The considerable tonnage of rail rolled to the 110- and 130-lb. sections has been in use a sufficient length of time to demonstrate that the sections are not altogether satisfactory. A study of the details of the dimensions and proportions of the sections indicates that a more economical distribution of the metal, with resulting increase in strength, may be obtained. Your committee defers action on the 110-lb. section and reports as follows on the 130-lb. section:

"In designing a rail section the following principles are applied: (1) the sections should be so designed as to give the maximum vertical and horizontal stiffness and strength for the weight of metal; (2) the proportion of base to height should be sufficient to insure stability against overturning; (3) the distribution of metal between the head, web and base should be such as will minimize the setting up of internal strains while cooling.



The new 131-lb. A.R.E.A. rail section is identical with the section developed by the Pennsylvania R.R. which has proved satisfactory in service. The 130-lb. section that it supplants was a compromise between the Pennsylvania and New York Central section. It never was rolled.

"The 130-lb. tentative sections submitted by a subcommittee embodied these principles. However, when they were compared with the Dudley 130-lb. and the Pennsylvania 131-lb. sections, the differences were so slight as to be measured by small fractions of an inch. The Pennsylvania 131-lb. section is the result of a very exhaustive study, and 1½ years' service in heavy tonnage tracks has demonstrated the superiority of its design.

"As there was so little difference between the Pennsylvania 131-lb. section, the Dudley 130-lb. section (of which no rail has been rolled) and the section proposed by the subcommittee, the committee saw the opportunity of reaching an agreement on a rail section that represented the best that could be obtained from the weight of metal, a section that already was in use by one of the largest users of rail and a section that could reasonably be expected to become a universally adopted standard. This agreement would meet the present-day demand for standardization and the attendant economies resulting from the elimination of a large number of slightly varying designs."

CHARACTERISTICS OF NEW A.R.E.A. RAIL

	Sq.In.	Per Cent
Area: Head =	4.57	35
Web =	3.43	27
Base =	4.86	38
Total =	12.86	100
Moment of inertia		89
Section modulus, head		23
Section modulus, base		27
Ratio moment of inertia to area		7
Ratio section modulus to area		2
Ratio base to height		0.84
Ratio height to base		1.19

Record Air-Conditioning Plants

Three air-conditioning plants for buildings, said to be the largest yet designed, have recently been announced. Two are for government buildings in Washington, and one is for an office building in New York. The latter system, costing more than $1,000,000, will be installed in the broadcasting studios and lower floors of the new 69-story RCA Building in Rockefeller Center, New York City, according to the Carrier Engineering Corp., which has been awarded the contract after completing air-conditioning installations in the two theaters of the development. Two batteries of centrifugal refrigerating machines will provide some 1,500 tons of refrigerating effect for summer cooling. One will take care of the National Broadcasting Co. studios from the third to the eleventh floors, the other will serve the basement, ground and first floors. The contract for the refrigerating equipment to be used in the Department of Justice Building and the Post Office Building in Washington has been awarded to the York Ice Machinery Co. In the former building, which will be air-conditioned throughout each of its seven stories, it is said that the refrigerating effect provided will be equivalent to the melting of 2,000 tons of ice per 24 hours. Freon, a colorless non-toxic, non-inflammable gas, will be the refrigerant used. In the Post Office Building, eight floors, the corridors and the cafeteria in the basement will be air-conditioned. The refrigerating effect will be equivalent to the melting of 1,450 tons of ice each 24 hours. Under extreme hot-weather conditions about 18,000,000 B.t.u. will be removed from the building every hour. Moisture will be removed from the air of the two buildings by dehumidifiers.

Fire Hydrants Assembled in Water Department Shop

Special equipment installed in Philadelphia central repair shop to facilitate work—Large castings purchased on contract, with city furnishing patterns

By Seth M. Van Loan
Deputy Chief, Philadelphia Water Bureau, Philadelphia, Pa.

FIRE HYDRANTS used by Philadelphia are made in the water department's own repair shop, being assembled from bulk-stock material and contract-purchased castings. Several new pieces of specially designed shop equipment have greatly facilitated the process of hydrant assembly.

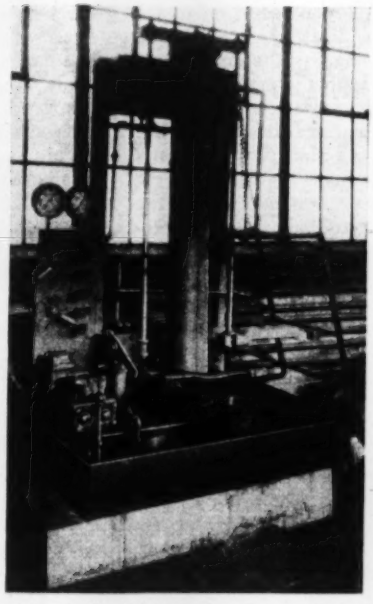


Fig. 1—Standpipe casting is placed on special test stand and subjected to 150-lb. water pressure.

The central repair shop of the Philadelphia water department, which was described in *Engineering News-Record*, May 11, 1922, p. 77, and Jan. 31, 1924, p. 196, is well equipped with lathes, planers, drill presses and auxiliary machines. It was designed to make all the repairs necessary on waterworks equipment, ranging from a 20-in. crankshaft to the smaller jobs that prevail in the maintenance of a water-supply system. Due to the adaptability of the shop the policy of undertaking the assembly of fire hydrants had been suggested and discussed on several occasions. After considerable study an assembly machine and an improved testing apparatus were designed and erected.

Gate valves and fire hydrants were fabricated by the department some years ago, but the practice was discontinued in 1920. Following that date, complete units were furnished under standard specifications and design. This policy is being continued in regard to gate valves.

The standard Philadelphia low-pressure fire hydrant is fabricated from 53 distinct parts. The iron castings are purchased through competitive bidding. Under the terms of the contract the water bureau lends to the successful firm its patterns for the term of the contract. The brass fittings are cast in the small foundry attached to the shop and are machined as needed. Bolts, gaskets and valves are bought in a finished condition, while chains for securing nozzle caps and the pipes for drip rods are cut in desired lengths from bulk stock.

The first step toward production is a test of the standpipe under water pressure of 150 lb. per sq.in. The testing machine with a casting set, secured in place for a test, is shown in Fig. 1. The castings are set in a vertical position and removed by means of an overhead trolley and chain fall. The blank heads over the standpipe openings are sealed by air, and a pump supplies water under pressure through the head at the base of the casting. Recording gages on the control board are set at a convenient height, and all parts of the machine are accessible to the operator.

The accepted standpipe is then moved to a lathe where the flanges are machined. It is then transferred on a light two-wheel cradle to an adjacent drill press at the side of which has been constructed an elevator to support the castings. A foot pedal regulates an air control for the operation of the elevator, affording a 43-in. drop below the level of the floor. The standpipe so lowered offers the upper flange at a convenient elevation to permit the drilling of the eight bolt holes, using a templet and a jig operating on the drill press.

The standpipe is then moved to an assembly machine. This device was designed by Harry Clemmency, superintendent of the repair shop. Two cylinders and piston with a stroke of 18 in. support the terminals of a yoke that holds the standpipe. By extending the pistons the casting is lifted, and it can then be inclined to a convenient angle for work. The height and position of the hydrant are regulated by air pressure, which is readily controlled by hand levers. While the casting is attached to the assembly machine the workman sets the nozzle, valve, operating stem, packing plate, drip rods, etc. Upon the release of the hydrant from

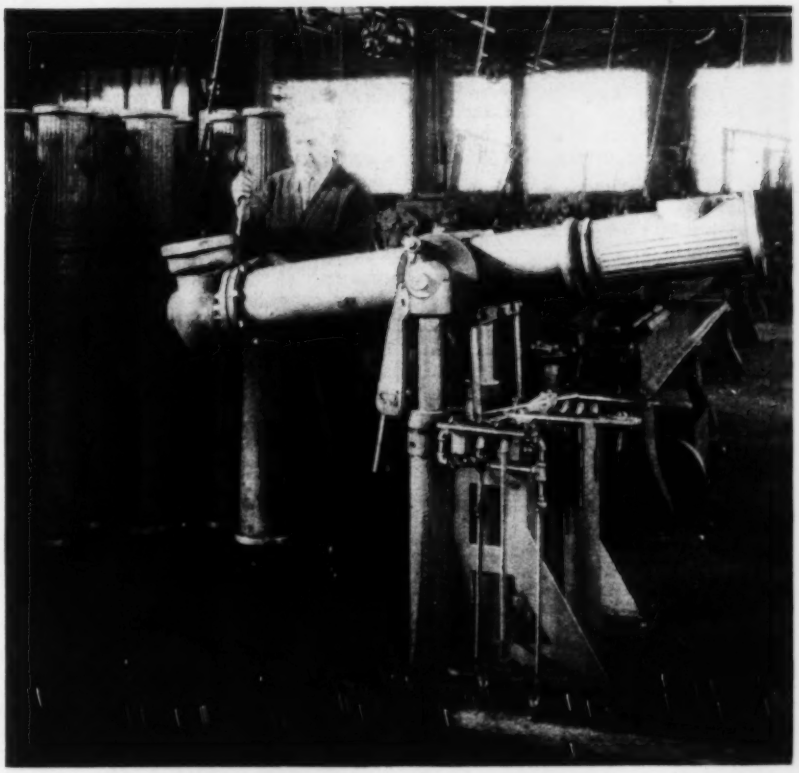


Fig. 2—Hydrant is held at convenient height and inclination in special assembly machine that is operated by air pressure.

the machine there remains only the final water test and painting.

To produce the finished hydrant, there are employed during the course of construction the part-time services of a molder, blacksmith, machinist and laborer. The work is under the inspection of the assistant shop superintendent, upon whom rests the responsibility of satisfactory production.

The shop, with sufficient and capable men assigned to fire-hydrant assembly, could produce ten complete units in a day. The general and normal activity of the repair shop requires a larger group than is now employed, and the desired force to keep hydrants moving is at times insufficient. Emergency work of various kinds may demand the use of the lathe or drill press, and the continuous service of these machines for hydrant assembly may not be advisable.

Until the return of normal shop personnel a cost approximation may not be assumed. The contributing factors of expense, including shop overhead, service of machines and the setting-up process, will be combined with the material cost, and the bureau officials feel confident that the total obtained will be a step toward economy.

Girders of Old Bridge Turned Over and Re-Used

Through-type, 80-ft. plate girders on bridge with 21-ft. roadway width dismantled, moved and re-used as deck girders with brackets providing 34-ft. roadway

By L. C. Hollister
Associate Bridge Designing Engineer, California Division of Highways, Sacramento, Calif.

THE RE-USE of six 80-ft. plate girders from a highway bridge eliminated by relocation provided the means for effecting a $6,000 saving in the work of the bridge department of the California division of highways on the present Ridge Route project. The old structure, consisting of three 80-ft. through spans, provided a 21-ft. width of roadway, but by turning the girders upside down and converting them to a deck design with outside brackets a modern 34-ft. width of roadway was secured. The work involved the complete dismantling of the old structure, including the dividing of the girders for highway transportation, fabricating the old members into the new design and erecting them on a new substructure.

In connection with the extensive relocation project on the principal state highway between Los Angeles and Bakersfield, the elimination of grades and curves on the old line resulted in the abandoning of the seventeen-year-old girder bridge built according to old state highway specifications. The survey for the relocation indicated that a structure about 222 ft. long, consisting of one 80-ft. and two 70-ft. spans, would be required at one of the stream crossings. The similarity in size and spans between the old bridge and the design required at the new location pointed to the possibility of re-use. Steelwork of the old structure was found to be in excellent condition, and estimates showed that it would be economical to remove the old girders and refabricate them to meet the new deck design.

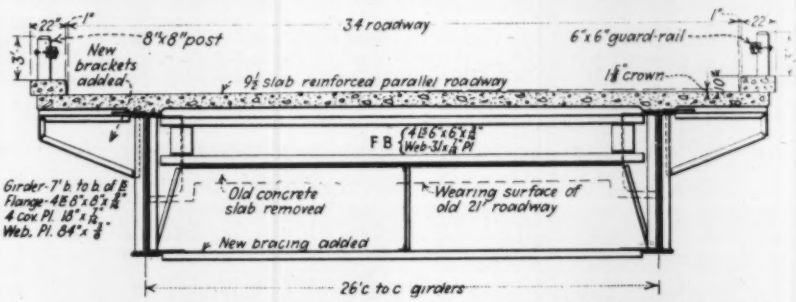
Design for the new bridge required turning the girders upside down, which placed the floor beams at the upper flange instead of at the bottom as they had been in the old through design. With the addition of new brackets on either side of the girders, a concrete floor slab and timber guard-rails, the old superstructure was completely revamped to provide a 34-ft. roadway width.

The old girders were built in 191[illegible] under unusually heavy live-load specifications, which simplified their re-use with a wider roadway and the modern specifications of the American Association of State Highway Officials. The make-up of the girder sections was one web plate 84x⅜ in. four 8x8x9/16-in. angles and four 18x7/16-in. cover plates. The fiber stress computed for this section with the wider roadway and an 80-ft. span gave a unit stress of 15,500 lb. per sq.in., which made it unnecessary to reinforce or strengthen the main body of the girders.

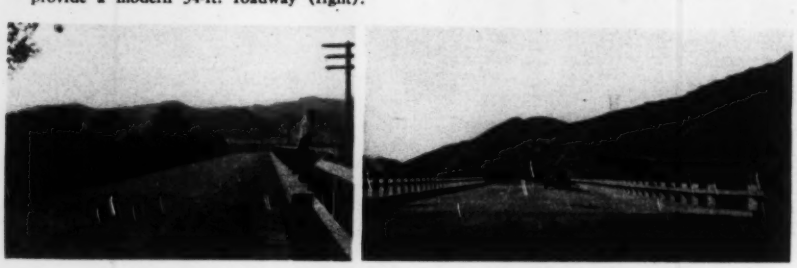
Floor beams on the old girders were at 10-ft. centers with large kneebraces engaging the top or compression flange. Bottom laterals, consisting of 3x3x5/16-in. angles, were removed and moved to the opposite flange, the new concrete deck slab providing lateral bracing for the new top flange. New 5½-ft. brackets were extended from the ends of each floor beam to provide for the additional width of roadway.

The old cast-steel shoes and bearing plates were pin-connected and found to be in excellent condition. The fixed bearings were anchored to the piers by 1¼-in. anchor bolts. Expansion shoes had been provided with roller nests, which were also in good condition. It was a simple matter to unbolt the shoes and bearings from their original position and drill new holes in the opposite flange.

The concrete floor of the old bridge was first removed with air drills, care being taken not to injure the structural steel. The next step was to dismantle the steelwork, which required the removal of about 4,500 rivets to disconnect floor beams and bracing and divide the girders in two sections. Sectionalizing of the girders was required because the 80-ft. length exceeded the legal limit of 75 ft. for truck and trailer load on state highways.



Los Almos Creek Bridge, showing old bridge turned upside down and brackets added to increase roadway width.



Before and after the upside-down treatment. The old through-girder design with 21-ft. roadway (left) and the new structure, using the same girders reversed, with brackets to provide a modern 34-ft. roadway (right).

On arrival at the site the girders and floor beams were refabricated. New bracing and angles necessitated the drilling of 1,330 holes through the old steel for the new connections. The old bearing shoes were removed and placed on the opposite flange. New piers and abutments had been built, and on this substructure the reconstructed steelwork was erected.

Following erection, the steel was thoroughly cleaned, sandblasted and painted. The plans were designed for riveted connections, with the contractor allowed the option of using welded connections if desired. The contractor chose to use the riveted connections detailed on the plans.

The cost of the work described was about $27,000 and is estimated to have been a saving of $6,000 over the cost of a complete new structure. The work was carried out under the direction of F. W. Panhorst, acting bridge engineer, California division of highways. A. K. Gilbert was resident engineer. The contract was held by Dimmitt and Taylor, Los Angeles.

Letters to the Editor

In Favor of Gravity Dams

Sir—In your issue of Dec. 1, 1932, p. 652, C. Maxwell Stanley discusses the merits and the possibilities of steel dams. Among the advantages attributed to the steel dam are: (1) the "more efficient" use of its material "than is possible in massive structures, in that the material is used to carry stress rather than to provide weight;" (2) "from the standpoint of uplift . . . a steel structure . . . has a decided advantage over a gravity dam;" (3) "the design is more determinate than that for almost any other material."

What is more interesting and pertinent comment on these advantages than the fate of the third and largest of the steel dams described by Mr. Stanley? This, the Hauser Lake Dam, built in 1905-1907 "across the Missouri River near Helena, Mont., was 630 ft. long . . . with a maximum height of 81 ft. The dam was constructed on a gravel foundation. One year after completion of construction a break occurred in the dam, resulting from underwashing of the foundation. The dam failed and was replaced with a concrete gravity section. There are no indications that the failure was in any way due to the steel construction."

In the Hauser Lake Dam the steel undoubtedly worked as "efficiently" as it would anywhere, the material was as uniform and the stresses were as determinate. Also the "decided advantage over a gravity dam . . . from the standpoint of uplift" was just as real—or just as unreal—here as elsewhere. Yet "a break occurred in the dam, resulting from underwashing of the foundation."

If dams could be positively attached and connected to their abutments and foundations, and if these abutments and foundations could always be uniform and impermeable, then many current abstractions would become safely applicable to construction practice. But foundations being as they are and being also an essential part of the entire construction, the writer is at a loss to understand why it should not be regarded as most desirable to have an extensive area of contact between a dam and the base upon which it rests. He also finds it very difficult to believe that any other type of dam is superior in respect to safaety, security and service to the gravity dam.

H. M. HADLEY,
Regional Structural Engineer, Portland Cement Assoc.

Seattle, Wash., Feb. 8, 1933.

Shrinkage in Mendota Bridge

Sir—In his letter (*ENR*, Oct. 27, 1932 p. 507), Charles S. Whitney raises a point that requires further discussion. He calculates from the figures given in my report of a recent survey of the Fort Snelling-Mendota bridge (*ENR*, Sept. 29, 1932 p. 371) that there has been shrinkage or flow in the concrete arches amounting to 0.0003 ft. per linear foot of arch. He computes that there has been a permanent lowering of the arch of 0.073 ft. at the center.

In my report I attempted to deal with the subject from a practical standpoint. I agree with Mr. Whitney that theoretically there would be a greater rise at the center of the span than at the pier, but not as great as he calculates it to be. There are various unknowns that affect the actual rise. First, the arch ribs have a much larger cross-section than the columns that support the floor above the piers and, therefore, they respond more slowly to changes in temperature. Second, the arch ribs are shaded from the sun for a much greater per cent of their length than are the columns supporting the floor.

To secure additional information, I repeated the survey again on Nov. 17, 1932, when the average temperature was 28½ deg. F. The temperature during the preceding week had been considerably lower, ranging down to zero, so that the temperature of the concrete may have been lower than the air temperature. The sun was shining brightly, whereas the weather was cloudy when the survey of 1926 was made. Therefore the readings obtained might be expected to show the arches lower than the temperature of the air would indicate, and the readings above the piers might if anything be higher.

The average measured elevation of eleven spans at the center was 0.042 ft. lower than the mean of the elevations over the piers. The average measured elevation without reference to piers at the span centers was 0.0025 ft. lower than the elevations of the same points in November, 1926. The spans used for the comparison are from pier No. 7 to pier No. 18.

The average elevation of six spans at the center was 0.072 ft. lower than the elevations over the piers compared with the elevations of Aug. 29, 1932. The spans compared are from pier 7 to pier 13. The average elevation at the span centers, without reference to piers, was 0.0867 ft. lower than the same points on Aug. 29. Mr. Whitney computes a difference of 0.108 ft. for 50 deg. difference in temperature. If we assume a difference of 56.5 deg. between Aug. 29 and Nov. 17, 1932, the theoretical difference in elevation at span centers by Mr. Whitney's method would be about 0.123 ft. The average measured difference was 0.072 ft., which is 0.051 ft. less.

By the method I use for computing the rise of a segmental arch due to an increase in length, the spring points remaining fixed, I find the theoretical rise for an increase of 56.5 deg. F. in temperature and the coefficient of expansion of concrete to be about 0.075 ft., which checks closely with the measured rise.

If I correct the value 0.042 ft. to the temperature of November, 1926, I find 0.038 ft. as the average of arch-center lowering, which might result from a shortening of 0.00015 ft. per foot in the length of the arch ribs. This is one-half the amount calculated by Mr. Whitney.

However, it should be noted that the measured elevations of Nov. 17, 1932, compared with those of the same month in 1926 do not indicate lowering of the centers of the arches since that date, more than would be due to temperature differences. At this time I can offer no satisfactory explanation for the apparent difference between actual and relative changes in elevations at span centers, but I would be inclined to give greater weight to the actual measured elevations.

The difference between the average difference in elevation for Nov. 17, 1932—namely, 0.042 ft.—and the average difference in elevation for Aug. 29, 1932—0.072 ft.—is 0.030 ft. and may be assumed to represent the actual rise in bridge-floor level at the arch centers in excess of the rise of the floor at the piers, for a change of 56½ deg. in temperature, whereas Mr. Whitney calculated 0.073 ft. for a change of 50 deg. in temperature.

WALTER H. WHEELER,
Consulting Engineer.

Minneapolis, Minn., Nov. 21, 1932.

Engineering News-Record

EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, W. G. Bowman, F. W. Herring, C. S. Hill, H. W. Richardson, W. W. De Berard, N. A.Bowers, J. I. Ballard.

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MARCH 30, 1933 Volume 110 Number 13

Conservation Camps

THE President's proposal to create an enlisted labor corps of unemployed men for forestation and related operations, radical though it may seem, is a logical extension of the made-work relief systems that have been used in many communities. As a pure relief measure, the plan will of course contribute little to economic rehabilitation or to business stimulation, but it is founded on the sound and essential idea of doing useful work of a kind that would not otherwise be done. Held within this scope, it appears a praiseworthy form of relief, furnishing not only subsistence and a small income but also an organized and disciplined life of activity. A more doubtful feature of the bill as well as of the President's message is the passage which refers to flood-protection construction. Such work is not adapted to a relief system. Reservoir, levee and channel improvement operations are distinct from casual surplus betterments such as tree planting and terracing, and necessarily imply thorough engineering study, the ability of the experienced constructor, specialized organization and a competent staff of workers. It would be both engineering and economic folly to entrust such work to the raw civilian conservation corps and to pay for it at a charity rate. As well might the corps be set to work building Hoover Dam as to build flood-protection works.

Reason for Quick Action

IN ADVOCATING the conservation camp scheme the President indicated that he would soon present a plan for the promotion of public-works construction as a prime source of employment. It is to be hoped that he will act speedily, both in formulating a plan and in rallying state and city governments to cooperative effort in carrying it out. These local governments are in the meantime steadily moving in an opposite direction and reducing construction in order to use for charity the money that should have gone for wages. In Ohio, for example, the press reports that "Roadbuilding holiday pleas gain ground," and explains that the legislature intends to use all construction funds for relief and schools. New York is moving in the same direction, and many other states are in the procession toward utter stagnation. It is not hard to foresee that the volume of unemployment will grow and relief demands rise still more, while public revenue will shrink; the destructive circle of the dole philosophy will work itself out. An interesting sidelight on the situation is that Ohio has done little or nothing to put the construction funds of the Reconstruction Finance Corporation to work in creating employment; in both respects it seems to be "lying down on the job." With such conditions prevailing it is plain that the President's re-employment program will have a bigger load to carry the longer it is delayed. The strongest influence that the national government can exert will be needed in order to reverse the defeatist psychology of local authorities.

Available Work

ONE OF the most readily available sources of work in addition to normal municipal construction is to be found in grade-crossing elimination. Plans have been prepared for many elimination projects, and plans for many others could be made ready for contracts quickly. New Jersey, for example, has some $20,000,000 of such work that could be started on short notice. Doubtless a like condition exists in most states. The work has lagged because the railroads were unable to finance their part of the cost. If money can be provided through a federal bond issue, construction can be undertaken quickly. Further, grade-crossing elimination work has a special advantage for a program of public work designed to provide productive employment in that the great majority of the dangerous crossings needing separation of grades are in or near the large centers of population, where the greatest unemployment exists. In all, there are 250,000 grade-crossings between railways and highways in this country. Though many of them may not need to be separated, it is fair to assume that the 13,000 now protected by gates or watchmen should be improved as soon as feasible. As the cost per crossing averages $100,000, the expenditure involved in that number alone will run over a billion dollars. The potentialities of that field, therefore, are obvious.

A Public Benefit

THE GREAT and largely unproductive burden that grade-crossing elimination puts on the railroads stands as the one major obstacle to the use of such work in reducing unemployment. No amount of public money can start the work going so long as existing laws require the railroads to bear a considerable part of the cost—generally 50 per cent or more. In the present emergency the public must put up all of the money if the work is to be undertaken on a large scale. At first glance this may appear a radical and unjustifiable proposal, but when it is realized that the public pays the bill anyway, either directly, as here proposed, or indirectly, through increased freight rates, it is not without justification. Also, the present era undoubtedly will mark the further nationalization of the railroad properties. The public having already put up millions of dollars to keep them intact, actual federal control and direction of railroad operations until the end of the present emergency now appears highly probable. This control doubtless will involve added investment of public funds. Hence there is little reason why the public should not put up the money for work that essentially is for the general good, the elimination of hazardous crossings and costly delays to highway traffic. It is an investment in the national transportation system, an investment that the public must make ultimately; it never will be more productive of good than now.

Businesslike Procedure

ANNOUNCEMENT of the government's intention to separate expenditures—and presumably also revenues—into operating and capital items means more businesslike administration in a way that is badly needed. No business concern can survive under the time-honored

practice followed by all our governments, from federal to city, of mixing the two classes of transactions indiscriminately. The result in all the governments is that fiscal matters are in hopeless confusion, budgets mean little or nothing, expenditures cannot be analyzed, and debt structures defy scrutiny. The practice bedevils both borrowing and taxing. It obscures the relation of outgo to income and contributes to waste and inefficiency. Good management is impossible under such a system, for no unit operation has a true record of cost and revenue. Under the proposed new system sane and business-like administration can develop and efficiency can be sought for and attained. Finally, the vital investment function of construction expenditures will be placed in its true light, and in consequence charges will be properly allocated and amortization of fixed investment will be adequately done. These matters are among the fundamentals of public credit, and underlie all faith and security in the nation's financial system.

Shallow Rail Heads Win

ADOPTION of a new 131-lb. rail section by the American Railway Engineering Association, as noted elsewhere in this issue, is not only an important step in the association's work for better rails, but marks the passing of the old rivalry and antagonism between advocates of deep-head and shallow-head types of rails. The outcome is a victory for the shallow-head type, and the victory is the more emphatic from the fact that the new section has been developed and put into practical service by the railroad which was for many years the staunchest upholder of the deep-head type. So general has been the trend toward the shallow-head type within recent years that many engineers probably have forgotten the long-time controversy, when the deep-head men (led by C. B. Dudley, of the Pennsylvania) argued for a big mass of metal to take the wear, while the shallow-head men (under P. H. Dudley, of the New York Central) argued that the smaller head could be given so much more effective work in rolling as to be superior in wearing quality. Experience endorsed the position of the latter group. This matter now becomes an item in the history of steel rails, and the shallow-head type of rail becomes practically universal.

Efficient Timber Jointing

NO SINGLE condition has done more to throttle the use of timber structures in this country than lack of an efficient joint. The art of the old master carpenters who fashioned our splendid timber bridges was largely lost when they died. And what was left was forgotten when steel and reinforced concrete were developed. The need for timber structures persisted, but it could not be wholly satisfied because no one had devised a method of jointing that was efficient enough or that would provide connections of sufficient capacity for large structures. This same deficiency does not exist in Europe, where engineers and inventors have developed and used several dozen ingenious and technically sound joint connectors. All types are based on the long-known fact that stress is not uniform along a bolt through a piece of timber, but is concentrated at the face of the timber. The connectors therefore are dowels of various types—plates or rings, plain or toothed—that are placed on the faces of the timber members at the joints, which then are held together by a bolt. The bolt is relieved of bending; the connectors carry the load in compression and shear; and the strength of the joint is thus greatly increased. Tests of some of these connectors have been made at the Forest Products Laboratory, as announced on another page of this issue; and in connection with the tests a timber railroad bridge was built in the state of Washington. With these connectors available to American engineers, some of the lost art of timber framing should be regained, and study and invention stimulated to the end that timber may assume a place in construction commensurate with its possibilities.

The Survey Situation

THE GEODETIC results that Major Bowie outlines on another page of this issue are of a kind to claim the interested attention of all engineers. Their intrinsic importance to engineering studies and construction operations justifies careful thought of the progress and present status of the vast triangulation network. But quite apart from this aspect of the case the national survey work, both geodetic and topographical, has special meaning in today's emergency.

In respect to surveying and mapping the United States is far behind other civilized countries. Our geodetic network is limited in practical value until intermediate points are established. Only last summer the American Society of Civil Engineers requested the government to undertake at once the provision of geodetic points at 25-mile instead of the present 50-mile intervals. The topographic surveys are even more in need of extension, for less than half the area of the country has been surveyed and mapped up to now, and at the present rate of progress the mapping will not be completed by the end of the century. Revision of imperfect early maps would add further to this time.

Engineering operations depend on good basic survey data, and without them large losses are incurred in planning and construction. These conditions, known to many engineers, demand and fully justify a schedule of work under which the mapping can be completed within a single generation. If such a schedule were begun this year, several thousand engineers and three or four times as many laborers would be given employment.

In view of the great value of the work and its important effect on one of the professions most severely affected by the economic crisis, it is desirable that engineers should unite in support of a movement to make this accelerated survey program an integral part of the re-employment efforts in which the government is about to engage. The emergency character of the geodetic work has already had official recognition, through its inclusion in the Emergency Relief and Construction Act of 1932. More specific and comprehensive action by Congress is now timely, in order that completion of these essential surveys may be initiated this year and the idle talents of thousands of engineers be employed usefully to the public benefit.

Only moderate funds are required. An eight-year geodetic program is estimated to require for the coming year less than half a million dollars. A twenty-year topographic program requires for the first year about four and a half millions, and somewhat more in the later years. Thus a total of five million dollars could initiate a national program that would bring about a greatly needed improvement in the country's technical facilities at exceptionally low cost and at the same time aid in the attack on unemployment.

NEWS OF THE WEEK

Eight Small Loans Totaling $423,000 Approved by R.F.C.

EIGHT LOANS, chiefly for water supply projects, were approved by the Reconstruction Finance Corporation on March 22. The total amounts to $423,000. The loans approved were $38,000 to Sulligent, Ala., for a new waterworks system, including a well and pumping plant; $20,000 to Thomasville, Ala., for improvements of the city's water supply system; $75,000 to Flemingsburg, Ky., for the construction of a new waterworks system; $40,000 to Greensburg, Ky., for a water supply and distribution system; $35,000 to Marion, Ky., for the construction of a reservoir, filtration and pumping plant to connect to the existing system; $65,000 to Owenton, Ky., for a new water supply system; and $100,000 to Virginia, Ill., for a new water supply and distribution system. The corporation also agreed to purchase $50,000 of 6 per cent bonds of the Tulsa (Okla.) Union Stock Yards, Inc., to assist in the financing of a stockyard consisting of pens, loading docks, sheds, water and sewer facilities and an exchange building at a total cost of $75,000. The site of the yard is just outside Tulsa on the St. Louis-San Francisco R.R.

Housing loan not approved

A loan of $8,000,000 to Fred F. French Operators, Inc., for the construction of Knickerbocker Village on the east side of Manhattan Island, New York, reported in these pages last week as having been made, has not yet been approved. It is understood that all details have been settled except the rate of interest.

Jones Beach development

The loan of $5,050,000 for development work at Jones Beach on Long Island approved last week was not authorized to be made to the Long Island State Park Commission as stated in the announcement last week but to the Jones Beach State Parkway Authority. Bills are now before the New York State Legislature to create a Jones Beach State Parkway Authority for the purpose of constructing and operating facilities needed to give better access to the ocean front at Long Beach and Jones Beach. The work to be financed by the loan includes the construction of the Meadowbrook causeway across Great South Bay, approximately 5 miles long with macadam pavement 44 ft. wide; 2.7 miles of 40-ft. wide reinforced-concrete pavement in the Jones Beach state park to provide a connection between the southerly end of the new Meadowbrook causeway and the southerly end of the existing Jones Beach causeway; 17 acres of reinforced-concrete parking field to accommodate 3,400 additional cars; repaving of 3.1 miles of existing Jones Beach causeway with a 40-ft. wide reinforced-concrete pavement, including a grade crossing elimination at the intersection with Ocean Parkway; 2.5 miles of connecting loop causeway to Long Beach from the new Meadowbrook causeway, paved with macadam 44 ft. wide. The Meadowbrook causeway will require the building of three bridges across navigable channels, including one bascule span, and three grade crossing elimination structures. Three bridges, including one bascule span, also will be required for the connecting loop.

To finance the loan it is proposed to charge a toll for the round trip on the Jones Beach and Meadowbrook causeways and for each direction on the connecting loop causeway to Long Beach.

The bill creating the Jones Beach State Parkway Authority authorizes it to issue negotiable bonds to finance its operation. The R.F.C. agreed to buy bonds bearing interest of 4½ per cent.

College buildings financed

On March 23 the R.F.C. agreed to purchase $185,000 of general obligation bonds of the board of trustees of the State Agricultural and Mechanical College of the Fourth District, Monticello, Arkansas. The money is to be used to construct two dormitories. In December the R.F.C. agreed to loan $175,000 to the same institution for two dormitories at Jonesboro, Ark.

Contract Signed for Long Tunnel

On Mar. 17, F. E. Weymouth, chief engineer of the Metropolitan Water District of Southern California, signed a contract with Wenzel & Henock Company, Milwaukee, for the construction of the 12.7 mile San Jacinto tunnel of the Colorado River aqueduct. This company was second low bidder with a bid of $7,339,100.

On Dec. 12 award of the contract was made to the Metropolitan Engineering Corp. for $7,331,815 but early this year because of difficulties involved in obtaining the necessary labor and material bonds the award was withdrawn and the Wenzel & Henock bid was reinstated.

Bids Opened on Large Turbines for Hoover Dam Power Plant

Bids on five hydraulic turbines of 150,000 hp. each and on two 55,000-hp. turbines for installation in the power plant at Hoover Dam were opened recently at the Denver office of the U. S. Bureau of Reclamation. The Allis-Chalmers Manufacturing Co. of Milwaukee submitted the low bid for the large turbines, $1,718,000, and the Newport News Shipbuilding & Dry Dock Co. of Newport News, Va., submitted a low bid of $338,000 for the two 55,000-hp. turbines. The bids have been transmitted to the Washington office for final action.

Bids on the turbines were called for originally on Feb. 3 but the opening was put off because of questions raised by the power and light department of Los Angeles.

Ohio Floods Recede and None Expected in Mississippi River

FLOODS in the Ohio River valley began to recede during the past week. The flood crest passed Cincinnati March 22 without adding to the damage there and at Owensboro, Ky. the river on March 24 was about stationary at a gage height of 43.8 or nearly 6 ft. above flood stage. At Cairo, Ill., where the Ohio joins the Mississippi River, the flood crest is expected to flatten out as the Mississippi River is moderately low above that point and no high water is expected.

Rainfall conditions resulting in the high water in the Ohio River and the anticipated effect of the Ohio River flood upon the Mississippi River are outlined in the following statement prepared for this journal by the Mississippi River Commission.

River commission report

"The recent Ohio River rise has resulted largely from rainfall occurring generally over the Ohio Valley March 18 through 21. A previous storm from March 13 through 15 had produced flood stages in the upper Ohio. Rainfall for the storm March 13-15 was 2.24 in. at Pittsburgh; 2.76 in. at Parkersburg; 1.18 in. at Cincinnati; 1.06 in. at Louisville; 0.44 in. at Evansville; and 0.31 in. at Cairo. Rainfall for the second storm from March 18 through 21 equaled 2.00 in. at Pittsburgh; 2.30 in. at Parkersburg; 4.30 in. at Cincinnati; 2.64 in. at Louisville; and 2.12 in. at Cairo. The rainfall from this second storm, added to the previous moderate rise, resulted in a rapid rise of the Ohio, which crested at Cincinnati on March 22 at 63.6 ft. on the gage. This gage height has been exceeded in 1883 (gage reading 66.33 ft.), 1884 (71.06 ft.), 1907 (65.2 ft.), and 1913 (69.9 ft.).

"The lower tributaries of the Ohio have contributed generally only moderate amounts to the present rise.

"The Mississippi River above Cairo, including the Missouri, is at a moderately low stage, the St. Louis gage reading on March 22 being only 8.1 ft., with continued low stages in sight.

"At Cairo the gage had fallen to 25.2 ft. on March 15, preceding the present rise. Below Cairo the principal tributaries are generally at low stages. The gage height of the Arkansas River at Little Rock was 6.7 ft. on March 22, and on the Red River at Alexandria was 20.4 ft. on the same date and falling.

"The March 18-21 storm which covered the Ohio Valley was generally light over the western tributaries—Red, Arkansas and Missouri—and at the present time only moderate contribution of these streams is in sight.

"As the sharp crest from the Ohio rise enters the Mississippi River at Cairo it will flatten out in traveling downstream unless future rains from the western tribu-

Break in the cofferdam wall at Lock 2, Allegheny River at Pittsburgh, caused by a string of barges swept loose by the rising water and driven against the wall.

taries augment it considerably. Present indications are that stages on the Mississippi River below Cairo will be generally about bankful. Without further rain, stages below the Arkansas River will be slightly below bankfull. At no place on the main river will the present rise endanger the levee system, and throughout the major portion of the river below Cairo only a small amount of water against the levees is anticipated."

Gage heights at the following points along the Mississippi River as of March 22 were:

	Present stage	Flood stage
Cairo	38.9 ft.	45.0 ft.
Memphis	22.5 "	35.0 "
Vicksburg	30.4 "	45.0 "
New Orleans	12.0 "	17.0 "

Cofferdams flooded at Pittsburgh

Damage in the Pittsburgh area was confined chiefly to the wrecking of river craft, mostly contractor's fleets, and the partial loss of the cofferdam at Lock 2 under construction on the Allegheny River. Low-lying areas on the north side of Pittsburgh were flooded. The maximum height of water recorded on the Pittsburgh gage during the recent flood was 29.6, the highest since December, 1927, when high waters reached 30.4 on the same gage. In the 1913 flood the maximum gage reading was 32.4, while the highest flood on record at Pittsburgh, in 1907, reached 38.7.

The rapid rise of water on both the Allegheny and Monongahela Rivers caught fleet owners unprepared and a string of coal barges broke loose on the Monongahela, crashed into a fleet of floating equipment owned by the Vang Construction Co. and tore the fleet from its moorings. The contractor's fleet ran against piers of the Liberty and Smithfield St. bridges and two towboats and one derrick boat sank in the channel.

Three locks are under construction in the Pittsburgh area, one at Montgomery Island on the Ohio near Beaver, and two at Locks 2 and 3 on the Allegheny just above the city. Booth & Flinn, contractor at Montgomery Island, managed to flood the immense cofferdam on that job in time to avoid damage. Vang Construction Co., building Locks 2 and 3, was not so fortunate. The cofferdam at Lock 3 was overtopped before it was fully flooded, though damage is thought to be slight. Before the cofferdam at Lock 2 could be flooded, a string of barges crashed into the steel cofferdam wall, carrying out several cofferdam cells and causing considerable damage.

Damage to Ohio highways

A preliminary estimate of the damage done to Ohio highways prepared by O. W. Merrell, places the damage to bridges and approaches at about $750,000. Actual estimates cannot be completed until the flood water subsides further.

No flooding at Dayton

Despite general flood conditions in the tributaries of the Ohio River, no floods were experienced at Dayton as a result of the flood control work carried out by the Miami Conservancy District on the Miami River following the disastrous flood of 1913. The present flood is unofficially reported to be the highest since the district built its retention reservoirs and other flood control structures.

Bids Opened for Proposed Dam on White Nile River in Egypt

The Egyptian Government has opened bids on the construction of the Gebel Aulia dam on the White Nile about 30 miles south of Khartoum. Four bids were received. The lowest was £2,074,581 (Egyptian money), about $7,000,000, from Pauling & Co., Ltd. London. The next low bid, £3,500 over the low bid, was submitted by J. W. Gibson, agents of S. Pearson & Son, Ltd., London, builders of the Sennar dam. A bid £250,000 in excess of the low bid was submitted by the contractors for the work of raising the crest of Aswan dam, Topham, Jones & Railton, Ltd., now incorporated as Sir Evans Jones & Abboud Pasha. The firm of Balfour, Beatty & Co., Ltd., of London, also submitted a bid. Owing to a difference in interpretation of the conditions laid down in the specifications, it is stated that the bids are not strictly comparable as to total amounts.

The dam will be for both irrigation and power.

The engineers for the project are Coode, Wilson, Mitchell and Vaughan-Lee, of Westminster, England.

Steel for New Orleans Bridge Shipped by River Barges

Steel for the Public Belt Railway and highway bridge over the Mississippi River at New Orleans is to be shipped from the Rankin plant of the McClintic-Marshall Corp. at East Pittsburgh by barges. The contract calls for 42,000 tons. The first shipment, including the erecting equipment, was made ready for movement last week and other shipments will follow as required.

New Set of Negotiators Proposed in Colorado-Wyoming Dispute

At a conference held recently between the governors of Colorado and Wyoming over the drafting of an agreement for the allocation of water from the North Platte River, it was decided to take the work of negotiating a compact between the two states out of the hands of the engineers who have been handling it and to place it in the hands of a group of business men in the hope of reaching an early settlement. The engineering negotiators have been deadlocked for some time and it is hoped that a new set of negotiators using the data assembled by the engineers may be able to reach an agreement. Colorado is anxious to come to an agreement so that water from the North Platte may be diverted into the South Platte River and Wyoming is anxious for a settlement with Colorado so that a final agreement with Nebraska can be reached. Authorization by Congress of the Casper-Alcova reclamation project hangs on an agreement between the states as to allocation of the water in question.

Denver Awards Pipe Contract for Water from West Slope

The Board of Water Commissioners, Denver, Colo., has awarded the contract for pipe for the delivery of water from Fraser River and Jim Creek to the west shaft of the Moffat pioneer tunnel to the Stearns-Roger Manufacturing Co. of Denver, the second low bidder on the pipe line. As noted last week, the Columbia Steel Tank Co. of Kansas City, Mo., was the lowest of the twelve bidders with bids of $142,550 and $141,995 for the alternate proposals for the pipe line. The Stearns-Roger bid was $152,959 and $153,310. Award was made to the second low bidder on the ground that the low bidder did not comply with the stipulations with regard to time of delivery of the pipe.

The award to the Stearns-Roger Manufacturing Co. is a contract of $73,528 for items 2 and 3 of the call for bids, namely, the Fraser River diversion conduit and the Jim Creek branch conduit. No award was made on item 1, the Moffat water tunnel conduit, as the board has decided not to install the pipe at this time but to proceed with the permanent work of lining the tunnel. Installation of a pipe line within the tunnel from the west shaft to the apex, it is reported, was considered in the hope that it might be possible to push the work fast enough to make the water available to relieve the water shortage anticipated during the coming season.

The Columbia Steel Tank Co. has appealed to the Board of Water Commissioners to reconsider its action.

U. S. Forest Service Outlines Its Plans for Emergency Work

TO GIVE greater effectiveness to President Roosevelt's initial relief bill, both as a relief and land conservation measure, R. Y. Stuart, chief of the Forest Service, has proposed amendments to extend its scope to include not only national and state-owned lands but land controlled by the federal or state governments, counties and municipalities, also private lands subject to cooperative arrangements acceptable to the federal agency concerned.

In proposing the amendments Mr. Stuart had in mind the 161,000,000 acres of national forest, of which 135,000,000 lie in the West, excluding Alaska, and only 7,500,000 acres in eastern states. Most of the 177,000,000 acres in the public domain, 71,000,000 acres in Indian reservations, 8,000,000 in national parks and more in other federal and state lands are remote from the heavily populated districts where the need for employment relief is acute.

As soon as the bill becomes law, Mr. Stuart will call a conference of federal and state forest officials to select the areas in which to commence work. Such work will include the stringing of telephone lines, building minor roads and trails, firebrakes, lookout towers, range fences and water holes, improvements at public camp sites, and many activities related to insect control and forest culture. There are 800,000 acres of national forest in the Tennessee basin in which work can be done that will contribute to the advancement of President Roosevelt's plans for its intensive development.

In the national forests alone, there is enough work to keep 250,000 men busy, according to Mr. Stuart. A recent estimate by the Forest Service puts the direct work immediately available for unemployment relief at 1,300,000 man-months, which would mean 218,000 men employed for one year of 150 4-hour days. A very incomplete estimate of work available on state, municipal and cooperative private land is 415,000 man-months. Thousands of men now are at work in forest camps. Many of these are employed at wage rates set for the $10,000,000 emergency fund made available to the Forest Service for the current year, but more have been recruited by the relief agencies in several states for employment in return for shelter and subsistence.

Canal Ordered Kept in Service

The Pennsylvania Railroad Company has been ordered by the Board of Public Utility Commissioners of New Jersey to keep the Delaware and Raritan Canal open to navigation until the courts have determined upon the rights of the owners of the canal to abandon it.

In December the directors of the United New Jersey Railroad & Canal Co., owners of the canal, voted to abandon it. The canal has been in existence since 1834 and connects tidewater on the Raritan River at New Brunswick, N. J., with the Delaware River at Bordentown. In 1871 it was leased to the Pennsylvania Railroad Co. The canal carries no traffic of importance.

Modern Municipal Building Considered for Mexico City

A project for the construction of a large modern building to house all the offices of the city government of Mexico City is under consideration, according to announcements by Aaron Saenz, chief of the central department of the federal district, an office corresponding to mayor. A site would be provided by razing the convent of San Pablo and the Rodriquez Puebla barracks in the central part of the city. Upon it the city would build both the municipal building and a public market at a cost estimated at three million pesos. The present municipal palace is three centuries old.

Construction of a New Intake Recommended for Cleveland

Though a special committee of the Cleveland Engineering Society, acting upon the request of the Cleveland city council, has recommended early construction of another water intake tunnel, new work in the water supply expansion program to be undertaken this year by the utilities department undoubtedly will be confined to the construction of the Parma reservoir, and the laying of mains and cross-connections. The city council has made available $4,000,000 for this work, construction of which will begin as soon as the council decides whether the work is to be done by direct labor or by contract.

The Cleveland Engineering Society committee pointed out in its report that recommendations included in the "3-H" report (Herron, Howson and Hoffman) on Cleveland's water supply made in 1929 could probably be deferred several years because the population had failed to reach the figure upon which those recommendations were based. The committee stressed the fact, however, that deferment did not mean abandonment, and that, because of the time required in which to build it, the third water tunnel should be started within two years or Cleveland would face a water famine about 1940. Records of the water department, the committee pointed out, showed that the water actually pumped from Lake Erie in 1932 was more than 99 per cent of the 260,000,000 gal. maximum which can be obtained through the two present sources of supply.

The "3-H" report recommended that a third tunnel, with needed pumping equipment, filtration facilities and distribution mains be ready for use by 1935. This recommendation was based on the assumption that the area served by the water department would have a population of 1,250,000 in 1930. Actual population of the whole county was 1,201,455, and that part of it served by the water department was approximately 1,190,000 in 1930. Discounting slight population losses in this area since then, and assuming a definite improvement in business conditions, the committee believes the population to be served by 1940 will be 1,400,000, or approximately the number the "3-H" report stated would have to be served by 1935.

The committee emphasized the fact that a breakdown in pumping facilities now fully used, or damage to either tunnel, would create an unprecedented water famine, and that a third tunnel must be started within the next two years.

Master Recommends State Support for Chicago's Sewage Plan

FINANCIAL support to the Sanitary District of Chicago by the state of Illinois has been recommended by Edward F. McClennen, special master appointed by the U. S. Supreme Court to conduct hearings in the case against the sanitary district brought by the lake states, other than Illinois. The lake states allege unjustified delay by Chicago in carrying out its program of sewage-plant construction as ordered by the Supreme Court to make possible a permanent reduction in the quantity of diluting water diverted from Lake Michigan into the sanitary district canal.

Chicago officials testified at the hearings conducted by Mr. McClennen that the delay has been caused by the inability of the district to finance construction because of the non-payment of taxes. The recommendation made by the master is that the Supreme Court direct the state of Illinois to contribute $35,000,000 per year to the district's program of construction.

License Law for Ohio Engineers Gets Favorable Consideration

A bill proposing to license engineers in Ohio has passed the state senate and has been reported out favorably by a house committee. It is expected that the bill will be passed before this session of the legislature ends. The law proposed in the bill is patterned after the model law drawn up by the American Society of Civil Engineers, though it departs somewhat from this bill in the matter of exceptions. As the bill now stands it will make it unlawful after Jan. 1, 1934, for the state or any political subdivision "to engage in the construction of any public work involving the practice of professional engineering or surveying, for which plans, specifications and estimates have not been made by, and the construction thereof supervised by, a licensed professional engineer or surveyor; provided, that this section shall not apply to the construction, improvement or maintenance of county or township highways; nor to any other public work wherein the contemplated expenditure for the completed project does not exceed $3,000."

City of Tacoma Plans Expansion of Its Water Supply System

The water department of Tacoma, Wash., has budgeted $1,335,000 for its construction program for 1933, a program contingent upon obtaining a loan of $1,000,000 from the R.F.C. Included in the proposed work is $889,000 for the construction of supply lines and $413,000 for miscellaneous improvements.

The city also has filed an application with the state division of hydraulics for permission to draw more water from the Green River for water supply purposes. A $3,500,000 extension to the system is being planned for, to take care of the increase in population from the present 170,000 to an estimated population of 200,000 in 1950.

Committee Named in New York To Report on Delaware Water

The mayor of New York, on March 23, appointed a committee to study the city's immediate need for water and to determine whether work on the proposed water supply from the head waters of the Delaware River should be inaugurated in the near future. The committee consists of 15 members headed by Peter Grimm, chairman of the Citizens Budget Committee, and includes two engineers, Lewis Nixon and J. Vipond Davies.

Chemical Treatment Stressed at New Jersey Sewage Meeting

Chemical treatment methods of sewage disposal received detailed attention at the meeting of the New Jersey Sewage Works Association at Trenton, March 23 and 24. In addition to the group of papers devoted entirely to that topic, a number of discussions had to do with sewage-works operation in which chemical treatment methods predominated.

Developments in recent years that tend to put chemical treatment on a different plane from what it occupied 30 or 40 years ago were described by L. L. Hedgepeth, of Philadelphia. As examples Mr. Hedgepeth cited the advance in knowledge of the chemistry of coagulation, the improved mechanical equipment that is now available and growing appreciation of the fact that chemical treatment can be utilized to improve the operation of an existing plant. J. R. Downes described the utilization of ferric chloride as a coagulant in the trickling-filter plant at Plainfield under his charge. Sludge volumes, he said, had been increased 40 to 50 per cent through the use of 400 lb. of coagulant per million gallons of sewage. The uses now being made of chlorine in sewage treatment were detailed by A. E. Griffin, of the Wallace & Tiernan Co.

Operating experiences of the sewage plants at Collingswood, Princeton and Freehold were reported by C. V. Dare, I. R. Riker and W. J. Schiverea, respectively. At the Collingswood activated-sludge plant, costs of operation during 1932 average $50.57 per m.g. At the Princeton trickling filter plant, which was put into service only last fall, the cost per m.g. was $33 for January and $31 for February. Trade wastes greatly handicapped the functioning of the Freehold trickling-filter plant during the early months of its operation. When the wastes were eliminated from the incoming sewage the difficulties were avoided, sludge digestion proceeding normally and the trickling-filter effluent showing satisfactory nitrification.

Other papers presented included "Application of Sewer Rental Law in New Jersey," by C. A. MacDonald; "Pollution of Bathing Waters and Effect on Health," by C. G. Wigley; "Practical Operating Data on Sprinkling Filters," by I. O. Lacy; "Comparison of Treatment of Fresh and Stale Sewage," by Wm. Rudolfs; and "New Rules Covering Licenses of Plant Operators in New Jersey," by J. B. Baty.

Officers selected for the coming year are C. H. Shute, president; W. C. Mallalieu and I. R. Riker, vice-presidents; Edward P. Molitor, treasurer; Paul Molitor, assistant secretary and treasurer; and John R. Downes, Bound Brook, N. J., secretary.

Canadian Waterworks Men Hold Meeting at Ottawa

With a registration of more than 350, the 13th annual meeting of the Canadian Section, American Water Works Association, was held at Ottawa, Ont., March 22-24. A symposium on the methods of charging for domestic water supplies was a feature of the meeting, some members favoring the flat rate system and others upholding the meter plan. Latest figures indicate that there are 559 plants in Canada with a total of 1,483,670 services and 294,548 meters. There are now 69 systems, large and small, with meters on all services.

Papers were given by C. J. Des Baillets, chief engineer of the Montreal Water Board, who spoke on the "Design and Installation of Large Water Mains"; and J. O. Meadows, sanitary engineer of Montreal, whose subject was "Treatment of Water for Industrial Purposes." Various water works systems in Canada were described by the engineers in charge of them.

A. E. Berry, secretary-treasurer, reported the association had not lost any members in the past year. Western delegates reported in favor of retaining membership in the Canadian Section instead of joining with the Minnesota organization, a plan which had been under consideration for several months.

A. U. Sanderson, assistant electrical and mechanical engineer, Department of Works, Toronto, was elected chairman of the Canadian Section for the ensuing year, while trustees elected for three year terms were F. P. Adams, city engineer, Brantford, Ont., and T. J. Lafreniere, engineer of the Department of Health, Quebec.

SOCIETY CALENDAR

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Chicago, June 27-30.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Chicago, June 26-30.

AMERICAN WATER WORKS ASSOCIATION, annual meeting, Chicago, June 12-16.

AMERICAN WELDING SOCIETY, annual meeting, New York, N. Y., April 27-28.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, annual meeting, Chicago, June 27-30.

ENGINEERS WEEK, Century of Progress Exposition, Chicago, June 25-30.

THE ASPHALT INSTITUTE, at its recent annual meeting, elected B. L. Boye president to succeed William H. Kershaw. Vice-presidents elected were Leroy M. Law, and A. M. Maxwell and J. A. Blood. W. W. McFarland was elected secretary and Herbert Spencer treasurer. J. E. Pennybacker continues as managing director.

THE NEW JERSEY ASSOCIATION of Professional Engineers and Land Surveyors at its annual convention held in Newark, N. J., March 15, adopted a resolution expressing strong disapproval of the present tendency to abandon public works as a means of producing government economies, urging upon state and federal officials the need for continuing public construction to maintain employment.

NEW YORK SECTION, AMERICAN WELDING SOCIETY at its regular meeting on March 23, listened to a lecture by H. M. Priest, American Bridge Co. on the design of welded joints for buildings and other static structures. Being among the first comprehensive presentations of the subject, the lecture attracted an audience of 500 or more engineers of the New York Metropolitan area. F. H. Frankland, American Institute of Steel Construction, presided.

Personal Notes

R. F. HOFFMARK, formerly vice-president of A. Guthrie & Co., Portland, Ore., has been appointed general manager of Woods Brothers Construction Co., Lincoln, Nebr.

JAMES E. GIBSON, of Charleston, S. C., has opened an office as consulting engineer under the name of James E. Gibson, Inc., specializing in sanitary engineering work and valuation and plant management.

JAMES WINSTON, former chief engineer of the Elizabeth Iron Works, Elizabeth, N. J., has opened an office as consulting engineer in San Bernardino, Calif., specializing in structural steel work.

JULIUS J. WARNER, for the past 20 years with the Cincinnati Builders Supply Co. and one of the pioneers in the development of ready-mixed concrete, is now affiliated with the Richer Concrete Corp., of Cincinnati, Ohio.

CHARLES P. SEEGER, formerly engineer for the Mexican Government on the Don Martin Dam, has been placed in charge of the construction of the dam at El Vado for the Middle Rio Grande Conservancy District.

BURWELL BANTZ, Chehalis, Wash., has been appointed county engineer, Lewis County, to succeed Roy Greene. Mr. Bantz served as city engineer for Cehalis for 12 years. He is a graduate of the University of Washington, class of 1909.

HERBERT J. BAKER, former engineer of inspection, Port of New York Authority, has been appointed to a like position with the Golden Gate Bridge and Highway District at San Francisco to organize and direct the inspection service for the new bridge.

JOHN W. WHEELER, highway contractor, Crown Point, Ind., has been appointed a member of the Indiana State Highway Commission. Mr. Wheeler is a graduate in civil engineering from Purdue University in the class of 1916 and has served six years as an engineer in highway work and ten years as a contractor.

R. T. CASH, assistant district engineer, District 3, Ottawa, Illinois Division of Highways, has been made acting district engineer for District 1, at Elgin, replacing GEORGE E. LAMB, who has held the position for many years. District 1 until recently embraced the north east section of Illinois including Cook County.

R. G. CONE, until recently general manager, Tacony-Palmyra Bridge Co., Palmyra, N. J., now is resident engineer for the Strauss Engineering Corp. on the Golden Gate bridge at San Francisco. Mr. Cone also served as engineer on the bascule bridge at Detroit and as resident engineer for the central section of the Delaware River bridge at Philadelphia.

WILBUR W. DAVIS has been appointed chief engineer of the Boston Transit Department, succeeding the late Ernest R. Springer. Mr. Davis was educated at the Massachusetts Institute of Technology, and has been with the Department and its predecessor organization, the Boston Transit Commission, for 31 years. He entered the service as a draftsman and

advanced through various grades to the post of assistant chief engineer in 1922.

H. Houghton Lauer, for 13 years chief engineer of the Atlas Portland Cement Co. and for the past two years assistant chief engineer of the Universal Atlas Cement Co., has resigned to enter consulting practice specializing in valuation of industrial properties and the design and reconstruction of cement and other industrial plants. His office will be at New York.

Henry F. Stubbs, who has been in charge for the Sumner Sollitt Co. of the construction of three recently-completed power developments for the Texas Hydro-Electric Corp. on the Guadalupe River in Texas, has been appointed superintendent of construction of Lock Four, on the Mississippi River, for the contractors, the Ouilmette Construction and Engineering Co., of Chicago.

John H. Moorhouse, formerly manager of the Michigan-U. S. Waterproofing Co., has been appointed city engineer of Highland Park, Mich., and the positions of city engineer and superintendent of public works of the city have been consolidated. Lawrence C. Whitsit, city engineer of Highland Park for the past 18 years, has been retained as consulting engineer to the city for a period of six months.

Obituary

George S. Van Der Werken, former superintendent of public works and an engineer in the employ of the city of Long Beach, Long Island, died at Brooklyn, N. Y., on March 26.

H. Gregory Barnhurst, Mid-West representative of the cement sales department of the Babcock & Wilcox Co., died at Chicago on March 18. Previous to his connection with the Babcock & Wilcox Co., Mr. Barnhurst was associated with the Fuller Engineering Co. and the Fuller Lehigh Co.

Charles E. Eveleth, vice-president of the General Electric Co., died at his home in Schenectady on March 25, following a long illness. Mr. Eveleth was a graduate of Worcester Polytechnic Institute in the class of 1899 and entered the testing department of the General Electric Co. in the same year. He was appointed a vice-president in 1927.

Percy H. Underhill, a structural engineer employed since 1916 by the Stone & Webster Engineering Corporation at Boston, died at Allston, Mass., March 19, at the age of 49. He had been associated with many important projects including the Conowingo and Rock Island developments, and recently had been engaged in valuation work.

Eugene A. London, chief engineer of the Groton Bridge & Manufacturing Co., Groton, N. Y., until its absorption in the American Bridge Co., died at his home in Groton on March 23. Mr. London graduated from the civil engineering course of Cornell University in 1880 and entered the service of the Groton Bridge Co. shortly thereafter. Since about 1901 he has been engaged in general engineering practice in Groton.

William J. Harvie, who until his resignation in 1926 was vice-president and general manager of the Auburn & Syracuse Electric Railway Co. and more recently with the New York State Education Department in charge of school building construction, died at his home in Richmondville, N. Y., on March 22. Mr. Harvie graduated from Syracuse University in 1901 and spent most of his active career in electric railway work.

Engineering Contracts and Capital

NEW AWARDS of heavy engineering construction contracts are slowly gaining after the set-back occasioned by the bank holiday earlier in the month. The total of awards reported for the past week is $11,994,000, as compared with $9,834,000 for the previous week and $8,339,000 for two weeks ago. Of the past week's figures, $8,888,000 represents public works awards and $3,106,000 is for private contracts. Federal government awards showed a considerable gain over the previous week, amounting to $3,933,000, as compared with $1,103,000 the week before. State and municipal lettings showed little change in total, though highway awards increased from 2½ millions to 3½ millions for the week just closed. In the private field, commercial buildings were heaviest in awards, amounting to $1,700,000.

New capital reported for the week was negligible, amounting to only $410,000. The Reconstruction Finance Corp. approved ten additional self-liquidating loans aggregating $5,658,000. The R.F.C. figures shown in the accompanying table have been revised to correspond with those given in the R.F.C. report dated March 21.

Contracts and Capital

CONSTRUCTION

(Thousands of Dollars)

	Weekly Average Mar., 1932	Four Weeks	Week Mar. 30 1933
Federal government	$2,487	$3,051	$3,933
State and municipal	7,643	4,229	4,955
Total public	$10,130	$7,280	$8,888
Total private	7,893	4,668	3,106
Week's total	$18,023	$11,948	$11,994
Cumulative to date			
1932		$269,511	
1933		214,292	

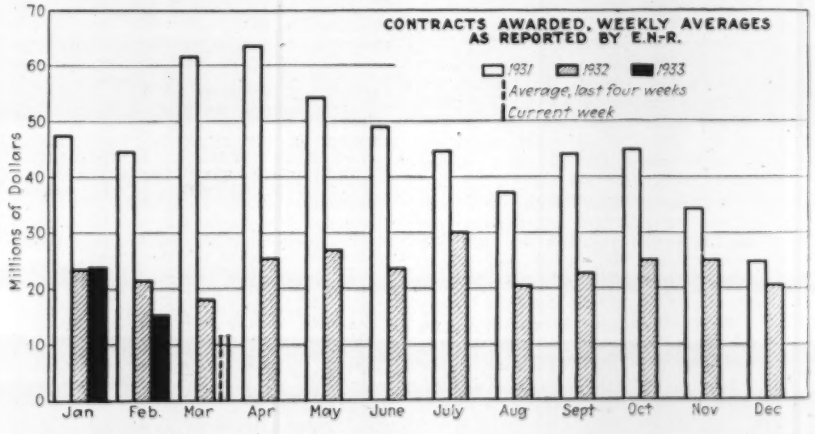
NEW PRODUCTIVE CAPITAL

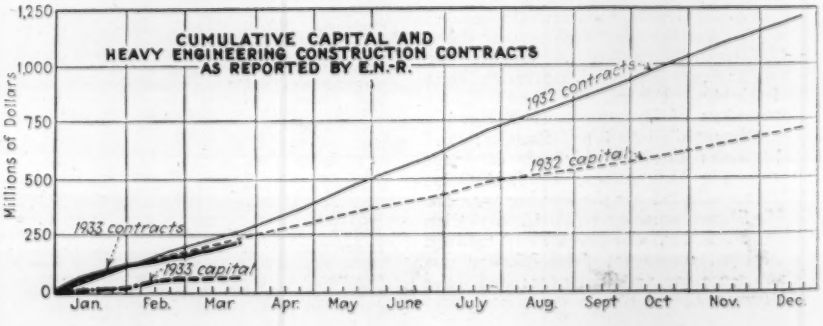
(Thousands of Dollars)

	Weekly Average Mar., 1932	Four Weeks	Week, Mar. 25 1933
New capital issues	$17,200	$1,778	$410
Cumulative to date:			
1932		$331,800	
1933		68,406	
R.F.C. self-liquidating loans:			
Approved current week			$5,658
Approved to date (including 1932)			191,191
Actual loans made (including 1932)			19,682

ENR Cost and Volume Index

E.N.-R. Cost		E.N.-R. Volume	
March, 1933	**158.44**	**February, 1933**	**87**
February, 1933	159.30	January, 1933	129
March, 1932	157.24	February, 1932	105
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.35	1930 (Average)	260
1913 Average	100		





Construction Equipment and Materials

Cast-Iron Roof Plates

The United States Pipe & Foundry Co., Burlington, N. J., has developed a cast-iron roof material of the interlocking type which it designates as the "Usicast" roof. The roof consists primarily of two castings, one a flat flanged or standard plate, and the other a semi-circular or cap plate. Plates are made flat with flanged sides to insure strength, with a center hood formed at the lower edge and extending upward to near the top, where it merges into the flat body of the plate. A stop is provided

Interlocking roofing plates made of cast iron

at either side of the top edge to hold the plate in place on the roof purlin.

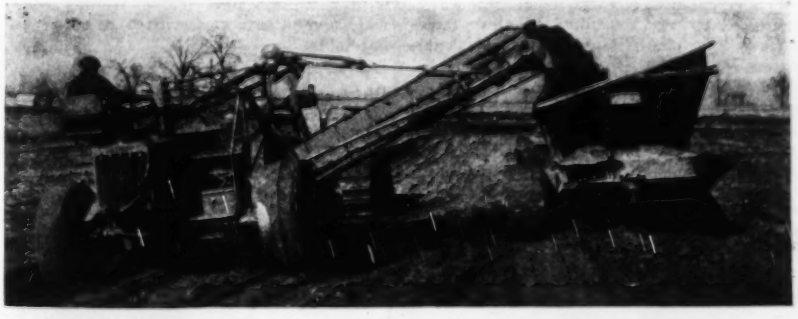
The cap plate is semi-circular in shape and has a lug extending downward near the lower end, the depth being such as to extend below the plate and the upper flanges of the roof purlins. In the lower end of the lug is a slot or keyway to receive the key or locking device. The lower end of the cap plate is closed with a lip extending below the lateral edge of the plate.

Elevating Grader of New Design

Caterpillar Tractor Co., Peoria, Ill., announces a large capacity power controlled elevating grader of new design. The machine incorporates an arched "A" frame to give ample clearance for the carrier and to permit a higher lift for loading large wagons. Three point suspension of the frame protects it from twisting strains and a swivel king bolt allows full oscillation of the front wheels and short turns. Drum type wheels are provided. Front and rear axles are extensible to balance the weight of the carrier.

Four power levers control adjustment of carrier and plow and all operating controls, including clutch, throttle and gong are grouped directly over the plow. A 46 hp. Caterpillar engine furnishes the power to operate carrier, power controls and automatic pan cleaner.

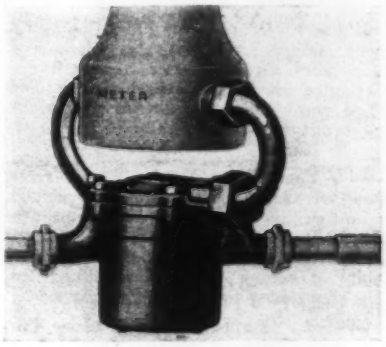
New elevating grader by Caterpillar Tractor Co.



Accessory for Water Meters Allows Low-Flow Registration

The Ford Meter Box Co., Wabash, Ind., has introduced a compounding device for water meters designed to cause the meter to register extremely low flows. The device is designated as a "Gulper" because it includes a small reservoir which accumulates the small flows and then passes the accumulation through the meter proper in a gulp.

The reservoir capacity is secured by means of a heavy molded and reinforced rubber bellows. Inside this bellows is the water which has already been gulped through the meter and measured by it. As this water is supplied to the small flows the bellows is contracted by the inlet pressure, which is on the outside of the bellows. The contracting of the bellows compresses a large bronze spring. When the bellows reaches a certain point, a tripping mechanism automatically snaps open the Gulper valve. When the valve is open, the bellows expands due to the compressed spring, circulating a gulp of water from the outside of the bellows through the meter and into the inside of the bellows. The volume of this gulp is approximately 5 cu.in.

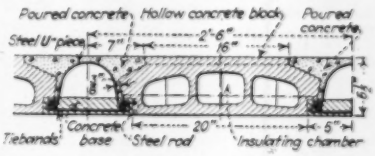


Water meters register extremely low flows through aid of "gulping" device

The device can be used with all ¾-in. or ¾x¾-in. standard meters. It ceases to function when the flow becomes large enough to register accurately on the meter proper.

Bauer Floor System Now Available in America

The Bauer system of floor construction, which has been widely used throughout Europe, is now available for use in America through Amerika-Interessen, Inc., Chrysler Building, New York, N. Y. The floor system consists of three elements: steel arch beams, hollow concrete blocks and poured concrete. The latter comprises



System comprises steel U-beams, concrete blocks and poured concrete

17 per cent of the finished floor area. The steel U-pieces, imbedded in light concrete bases, form composite beams and form the skeleton of the floor structure. They are laid on about 30 in. centers and in the 20-in. gaps are laid the overlapping concrete blocks. The remaining 17 per cent of the floor is then leveled out with concrete. No forms are required.

Business Notes

CAPITOL STEEL CORPORATION of New York, N. Y., fabricators and distributors of reinforcing steel products for concrete work, announce the opening of a branch office at 253 53d St., Philadelphia, Pa.

GOULDS PUMPS, INC., has anounced the acquisition of the Hydroil Corp., of Lebanon, Ind., manufacturers of oil purifying apparatus. The Lebanon plant is being discontinued and the business and equipment transferred to the Seneca Falls plant of the Gould Co.

C. MARSHALL TAYLOR has been made manager of the New Products Division of the G. M. Basford Co., New York advertising agency. For the last six years Mr. Taylor was vice-president and general manager of Curtin-Howe Corp., timber preservation engineers.

P. A. ANDREWS, vice-president and assistant to the general sales manager of the Johns-Manville Sales Corp., has recently been appointed an executive vice-president of that concern. He will be general sales manager of building material products sold to building material and lumber dealers.

GENERAL AIR CONDITIONING CO., INC., is the name of a new organization which is offering engineering service in the design and installation of industrial air conditioning systems. The main office is at 155 East 44th St., New York City. M. Hitchen is president, A. H. Glogston, vice-president, and David H. Knowles is secretary of the new organization.

SUPERIOR UNITED CORPORATION, Chicago, is the name of a new company made up of the merger of the Superior Construction Equipment Company, the G. F. Lowe Company and George Hillsman, three organizations doing an equipment distribution business in Chicago for 10 to 15 years. The new corporation is an Illinois incorporation, licensed to do business in Indiana. It will cover northern Illinois and all of Indiana. The principal accounts handled are Chain Belt complete line, Butler bins, LeRoy compressors and Heltzel forms.

New Lettering System

A new type of lettering system, known as the "Leroy Lettering System," is announced by the Keuffel & Esser Co., Hoboken, N. J. The new system involves the use of a template on which the standard letters are engraved and which also has a long continuous groove cut in it. The lettering apparatus comprises a scriber holding a small vertical lettering pen and tracer point at its forward end and a tail point which slides in the groove of the template. When the tracer point follows the grooved character in the template, uniform letters are produced on the drawing paper above.

The Leroy lettering system

New Publications

Expansion Joints. The Yarnall-Waring Co., Philadelphia, Pa., has issued a bulletin describing the Yarway cylinder guided expansion joint, for use in steam lines.

Condulets. Crouse-Hinds Co., Syracuse, N. Y., has issued a 36-page bulletin describing explosion-proof condulets for hazardous locations.

Manometers. Bacharach Industrial Instrument Co., Pittsburgh, Pa., has issued three bulletins describings types MG, MF and MTB direct-reading manometers. Types MG and MF are vertical-tube manometers and type MTB is of the inclined-tube type.

Sand Washing Equipment. The Universal Road Machinery Co., Kingston, N. Y., has published a 16-page illustrated booklet describing the sand and gravel washing and handling equipment manufactured by the company. The equipment described includes screens, washing boxes, conveyors, elevators, crushers, bins, hoists and draglines.

Road Machinery. Caterpillar Tractor Co., Peoria, Ill., has published a 48-page booklet on low-cost earth moving in the construction of roads, canals and embankments. The booklet is entitled "The Construction of Low Cost Roads, Canals and Embankments with Caterpillar Tractors and Road Machinery."

Power Shovel. Bay City Shovels, Inc., Bay City, Mich., has published Catalog 30-A which describes the company's model 30, standard half-yard shovel. The shovel is convertible to dragline, skimmer, clamshell or 6-ton crane. The catalog contains complete detailed specifications, working range diagrams and illustrations of the shovel.

Crushers. Universal Crusher Co., Cedar Rapids, Iowa, has published a 24-page booklet describing the company's line of stone and gravel crushing equipment. The equipment illustrated and described includes force feed crushers, crushing rolls, elevators, screens, conveyors, bins, hammer pulverizers and the unit and dual crushing, screening and loading plants.

Stainless Steel. Republic Steel Corp., Youngstown, Ohio, has published a 14-page brochure containing information on the architectural applications of Enduro stainless steel, its fabrication, properties, and shapes and finishes available. Copies will be sent upon request to those interested. The booklet is designated as bulletin 217-B.

Hoover Dam. "Hoover Dam" is the title of a 16-page illustrated bulletin published by the Babcock & Wilcox Co., New York, N. Y. This publication describes briefly the Hoover Dam project as a whole and in greater detail the welded plate steel pipes that are to be fabricated and installed in the hydraulic power and normal-flow control tunnels by the Babcock & Wilcox Co. Copies of the bulletin may be obtained by addressing the company at New York.

Gearmotors. An eight-page illustrated publication describing Westinghouse gearmotors has recently been announced by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. These single and double reduction gearmotors consist of a simple all-external-type speed reducer combined with a standard motor. The illustrations include several applications together with detailed views of each model. Tables of output speeds for each model are included.

Refuse Incinerators. The Decarie Incinerator Corp., New York, N. Y., has just published a 24-page booklet entitled "Decarie Basket-Grate Incinerators" which describes in detail the garbage and rubbish incinerators manufactured by the company. In addition to explaining the operation of steel water-jacketed and refractory lined furnaces for the incineration of garbage and refuse, the booklet also describes an incinerator for the destruction of sewage screenings.

Crane Makers Object to Passing Out Drawings of Equipment

Based on the idea that the practice of the purchaser in requiring detail drawings of standard equipment works a hardship on the manufacturer and is not justified, the members of the Locomotive Crane Manufacturers Association have resolved to refrain from furnishing detail drawings of standardized products, except when justified by the needs of an emergency breakdown.

The organization feels that the manufacturers drawings are his stock in trade representing a costly engineering skill and technical knowledge which would not be asked for in specifications if a separate charge were made. In many cases the drawings represent the result of years of research and experience absolutely dependent upon a heavy capital investment in plant and equipment. Further, the manufacturer feels that his product suffers from faulty repairs of contractors guided by the drawings but otherwise unqualified and inexperienced. This may impair the efficiency of the machine to the manufacturers discredit.

New Equipment in Brief

Diesel Tractor. The Linn Manufacturing Corporation, Morris, N. Y., have announced a new Linn tractor equipped with a six-cylinder Linn-Cummins high-torque diesel engine. This is to be known as Model D-33.

Waterproofed Cement. The Coplay Cement Manufacturing Co., 521 Fifth Ave., New York City, announces that it is now marketing Saylor's portland cement combined with R.I.W. Toxement waterproofing compound, mechanically mixed at the cement plant.

Pipe Tools. The Borden Co., Warren, Ohio, announces the Beaver power adapter, a lightweight portable pipe machine; the No. 12-R Beaver ratchet, a self-contained and adjustable threader, and the No. 100 tubing cutter, a simple, low priced tool that cuts tubing square without burrs.

Pumping System. The Luitwieler Corporation, Rochester, N. Y., has introduced a water pumping system which supplies water under constant pressure regardless of volume. The unit comprises a pump, storage tank, air compressor and receiver, together with incidental valves and regulator devices.

Shaft Coupling. A new flexible shaft coupling has been announced by the Link-Belt Co., Chicago, Ill., which consists of two cut-tooth sprocket wheels and a piece of roller chain to connect them. All working surfaces are machined to close tolerances. The chain is closed by a pin-and-cotter link.

Irrigation Pumps. A new 4-in. side-suction belted pump, designated the Rain Pump, designed for use with portable irrigation systems, is announced by Byron Jackson, Berkeley, Calif. The manufacturer states that the new pump has an efficiency of from 75 to 80 per cent at all speeds to give the requisite pressure.

Shouldering Attachment. Western Wheeled Scraper Co., Aurora, Ill., has introduced a shouldering attachment for use with its elevating grader. The attachment consists of a blade fastened to a frame rigidly attached to the elevating grader in place of a plow, an auxiliary blade for cutting the slope to the ditch, and a screw conveyor to carry excess dirt to the elevator belt.

Mechanical Data. Fred Wuchert & Co., Astoria, Long Island, N. Y., is manufacturing a vest-pocket brass scale on which are stamped standard dimensions for screw threads, pipes, wire and sheet metal and keys and key seats. The scale carries a slide into which a window is cut, allowing the various dimensions to be read from each scale.

Concrete Waterproofing. A new method of peptizing stearic acid has been developed by the Master Builders Co., Cleveland, Ohio, and is being used to produce a concrete waterproofing compound, known as Stearox 30. The new product is in the form of a soft paste and contains 30 per cent stearic acid. Ammonia, calcium, potassium and other mineral salts are eliminated in the new compound.

Saw Rig. Chain Belt Co., Milwaukee, Wis., has announced the new Rex saw rig designed to handle all types of cuts found necessary on construction jobs. The new rig is powered by a 10-hp. four-cylinder gasoline engine with the engine crankshaft riding on ball bearings. The unit is built with a welded steel frame, is only 28 in. wide and is equipped with a patented tilting table.

Electro-Magnet Vibrator. Syntron Co., Pittsburgh, Pa., has announced a new line of electro-magnet vibrators for vibrating concrete during construction work. It consists of a horseshoe magnet and an armature, with the gap held open by springs. By the use of a pulsating current the gap between the magnet and armature is closed 3,600 times per minute on 60-cycle current, the heavy mass of the armature setting up vibrations that can be applied in a direct line.